Working Paper No. 7

COMPARISON OF ALTERNATIVE COMMUNICATIONS AND DATA PROCESSING DESIGNS FOR THE CONUS LOGISTICS SYSTEM

10 October 1962

Contract No. Nonr - 3642(00)

Dunlap and Associates, Inc.
429 Atlantic Street
Stamford, Connecticut

This working paper is part of an ongoing research study conducted by Dunlap and Associates, Inc., under the sponsorship of the Bureau of Supplies and Accounts. The general purpose of the study is to assist in the development and evaluation of promising alternative designs for the future logistic system of the Navy.

This document is one of a series of working papers. The series is intended to furnish up-to-date information on research accomplishments, to help identify deficiencies in information or understanding, and hence to assist in determining the areas that should be emphasized in future research efforts. At a later stage a larger analytical effort, incorporating results from the series of working papers, will be undertaken.

The material presented in this document is preliminary. All results and conclusions are subject to revision as the study progresses.

The help of both military and civilian personnel in many different parts of the Navy is gratefully acknowledged. It is especially appropriate to record the invaluable assistance and guidance provided by the Bureau of Supplies and Accounts, particularly by Captain Edward K. Scofield, Assistant Chief for Research and Development, by Commander Herbert F. Mills, Director of the Advanced Logistics Research Division, and by Commander William B. Farley, Director of the System Research Division.

TABLE OF CONTENTS

I. INTRODUCTION

The purpose of this working paper is to analyze in a preliminary manner promising alternative designs for the communications and data processing portion of the Navy logistics system in the Continental United States (CONUS). Two alternative designs are investigated. The two designs are radically different and should be regarded as representing two different families of alternative designs. Minor modifications can be made in either design with out seriously altering the conclusions in this paper.

The first alternative considered is the present communications and data processing system extrapolated to reflect current Navy plans and trends. Basically, it consists of automatic data processing equipment at all major supply activities (stock points, inventory control points, etc.) with the supply activities interconnected by the Switched Circuit Automatic Network (SCAN). The second is an integrated data processing system consisting of two large central data processing sites operating in parallel, with input/output equipment located at stock points, inventory control points, etc. A communications network interconnects the input/output equipment with the equipment at the data processing sites such that all equipment can operate on-line.

This paper describes these two alternative designs and then compares them in terms of various aspects of cost and performance. It is concluded that the second alternative appears to be much more desirable than the first. A method for implementing the second alternative is suggested. Finally, recommendations are made as to what actions the Navy should take at this time.

The scope of this paper is restricted to the CONUS logistics communications and data processing system. Of course, there are interrelationships between possible changes in the CONUS communications and data processing system and possible changes in other portions of the Navy logistics system. For example, the development of high reliability, long endurance ships and components might significantly reduce the dependence on spare parts and perhaps make centralized data processing much less attractive. However, analysis of such interrelationships will be deferred to future working papers.

The body of this paper is divided into six parts of which this is the first. Part II outlines recent developments which are likely to have significant impacts on the future design of the Navy logistics communications and data processing system in CONUS. This serves as background for the main portions of the paper. Part III describes the two alternative designs which are being considered for the Navy logistics communications and data processing system in CONUS. Part IV compares these designs in terms of various aspects of cost and performance. A method for implementing the second, and more promising, alternative is outlined in Part V. Part VI summarizes the central points in the paper and presents some recommendations as to what actions the Navy should take at the present time. Some readers may wish to review that part before reading the body of the paper.

In addition, the paper contains three appendices which provide detailed calculations and other supporting material for some of the comparisons presented in Part IV. The appendices are concerned with comparative equipment costs, personnel costs, and elapsed times, respectively.

II. TRENDS

A. General

Recently, Deputy Defense Secretary Roswell Gilpatric is reported to have said that there is "no alternative" to the "very pronounced tendency to centralization" within the Department of Defense.[1] This statement summarizes current trends in the Defense Department. Its accuracy--aside from the question of alternatives--is supported by many events which have occurred within the last two years. The trend toward centralization of decision making is having a major impact on many aspects of all military services, including the Navy's logistics system.

One of the major forces underlying the trend toward centralization is the rapid development of automatic data processing capabilities together with the development of rapid, high-capacity methods of data transmission. Automatic data processing capabilities and high-capacity data transmission tend to promote standardization of data formats, reporting techniques, operating procedures, etc., and the collection and processing of data at central locations. These tend to make centralized decision making practicable. Centralized decision making, in turn, promotes standardization and the installation of automatic data processing and data communication facilities.

The remainder of this section briefly outlines significant recent developments which pertain more or less directly to the design of future communications and data processing systems for the Navy logistics system ashore. It is noteworthy that each of these developments represents a move toward increased standardization and/or centralization.

B. Defense Supply Agency

The Defense Supply Agency (DSA) was established on 31 August 1961. Since then it has taken over many of the commodity managers from the individual services and has consolidated them into nine defense supply centers. Each defense supply center performs functions for all of the military services

[1] Armed Forces Management, June 1962, page 13.

that are similar to the functions that an inventory control point (ICP) performs for the Navy. It is likely that DSA may take over more of the service commodity managers in the future.

The nature of the future DSA distribution system is still under study and as such the following comments must be treated as tentative. A report, entitled Defense Supply Agency Distribution System and published by DSA in April 1962, contains recommendations concerning the type of distribution system that should be adopted. If these recommendations are accepted, all DSA defense supply centers would operate under more or less standard procedures and would exercise centralized control over all issues of DSA material. In particular, by 1964, DSA would have seven large regional distribution depots, each of which would stock the full range of DSA commodities. Each of these distribution centers would have a routing center. All service activities in a given region would submit all requisitions for DSA materials to the routing center, which would forward the requisitions to the cognizant defense supply centers for processing. A possible exception is that certain service activities (particularly industrial activities) with high usage rates would be designated as direct supply support points for selected classes of items. Activities so designated would deal directly with the cognizant defense supply centers concerning those items. The report also indicated that the DSA depots would be connected to the defense supply centers by high-speed communications and in-line processing[1] with interrupt features to accommodate priority transactions.

A memorandum from Deputy Secretary of Defense Roswell Gilpatric on the subject, Depot Distribution System for Defense Supply Agency Material, dated 6 August 1962, provides additional information on plans for DSA. According to this memorandum, by 30 June 1964, DSA will have seven large, regional distribution depots, each of which will stock the complete range of DSA commodities to the fullest extent practicable. In addition, DSA will have five depots which will be specialized as to type of material or scope of support. The latter include the Navy's tidewater depots located in Bayonne, Norfolk, and Oakland. At these depots DSA will arrange to position the inventories, but the Navy will receive, store, and issue the materials for DSA.

[1] The term "in-line" processing, as used herein, means the processing of data without sorting or any prior treatment other than storage.

In general, it appears that, if the concepts underlying the development of DSA are implemented, the DSA distribution system will have a high degree of centralization of management control and of stocks, relatively standard operating procedures, and substantial use of high-speed data communications. However, there are many unresolved problems concerning how the concepts underlying DSA can be implemented. It is still too early to say how DSA will actually function and whether DSA will be successful in reducing the costs and improving the performance of the military supply systems.

C. Defense Communications Agency

The Defense Communications Agency (DCA) was established in 1960. As is the case with DSA, DCA serves all of the military services and has taken over some of the functions that formerly were performed by the separate services. DCA has control of all worldwide, long-haul, government owned and leased, point-to-point communications circuits, terminals, control facilities, and tributaries required to provide military communications from the President down to the level of the unified and specified commands and their component and subordinate commands. However, DCA does not control tactical communications which are self-contained within tactical organizations, or terminal facilities of broadcast, ship-to-shore, ship-to-ship, and ground-air-ground systems.

D. MILSTRIP

The Military Standard Requisition and Issue Procedure (MILSTRIP) was installed on 1 July 1962. It consists of a common language of codes and standard documentation for supply communications among activities within a single service and among activities in different services. MILSTRIP is being used by all military services and for all commodities with only minor exceptions. The Navy portion of MILSTRIP is called NAVSTRIP.

The basic language medium in MILSTRIP is the 80-column punch card. Through the use of a document identifier code, this card is used for the following types of documents: requisition; supply directive; redistribution order; passing order; cancellation; referral order; supply status; follow-up; follow-up answer; material release order; material release confirmation; material release denial (warehouse refusal); shipment detail card; shipment status card.

These punched cards can be used by most types of data processing equipment. They are ideally suited for data transmission via transceiver networks. When transceivers are not available, punched cards can be sent between activities via mail. MILSTRIP also provides a standard handwritten form for supply documents which is used when punch card equipment is not available.

A new Material Issue Priority System has been made an integral part of MILSTRIP. This system establishes uniform criteria for requisitioners to affix priority designator codes to their requisitions. Also, it establishes uniform time standards for measuring performance efficiency of supply activities. In general, the new standards are much more stringent than the various standards previously used.

E. MILSTAMP

Military Standard Transportation and Issue Procedures (MILSTAMP) are being studied by the Defense Traffic Management Agency, which is a DSA activity. MILSTAMP is intended to provide a common language for codes and standard documentation in the transportation area that will be used by all military services. Also, it will provide uniform sampling procedures for measuring performance times.

F. SCAN

On 5 January 1962, the Navy joined the Switched Circuit Automatic Network (SCAN). This is a communications network which interconnects all of the major Army, Navy, and Marine Corps activities in the Continental United States (CONUS). Data are transmitted over multichannel telephone lines leased from the American Telephone and Telegraph Company. SCAN switching terminals are located at Frederick, Maryland; Rockdale, Georgia; Hillsboro, Missouri; and Santa Rosa, California. Each of the switching terminals is fully automatic, and each pair of switching terminals is directly interconnected by several trunk lines.

About 50 Navy activities have direct connections to one of the four switching terminals. These activities can communicate with each other or with Army activities without any manual relay. Additional Navy activities are served by small point-to-point networks, private lines, and dataphones, which permit them to communicate data to one SCAN subscriber who then transmits the data to other SCAN subscribers by means of manual card relays.

SCAN terminal equipment receives data directly from punched cards, magnetic tape, etc., and transmits them in the same form. Thus, the SCAN system is well suited for communicating MILSTRIP documents.

BuSandA personnel have indicated that there is a possibility that within the next year or so the SCAN system will be discarded and replaced by AUTODEN, which will serve all of the major Army, Navy, Air Force, Marine Corps, and DSA supply activities in CONUS. AUTODEN is essentially the present Air Force logistics communications network (COMLOGNET) under a different name. It is more sophisticated and more costly than is SCAN. However, for the purposes of this paper the capabilities of AUTODEN and SCAN may be regarded as equivalent.

G. BuSandA Uniform Data Processing Systems

BuSandA is developing uniform data processing systems for stock points and ICP's. The primary purposes of these systems are to improve and standardize decision rules, computer programs, processing procedures, and other aspects of data processing software at stock points and ICP's. Changes in data processing equipment are also planned. As the development of a uniform data processing system for ICP's was just started last February, the system is still in the planning stage. However, development of the system for stock points is well along. BuSandA expects to begin to install the first system, which will involve a new medium-sized computer, at NSD Newport this month. Other new equipment to be installed during fiscal year 1963 includes a new large computer at NSC Norfolk, new medium-sized computers at NSC Bayonne and NSC San Diego, and additional electronic accounting machine (EAM) equipment at NSC Pearl Harbor. It is possible that the system will be extended to stock points managed by BuShips and BuWeps as well as BuSandA.

H. FMSO

The Fleet Material Support Office (FMSO), located in Mechanicsburg, Pennsylvania, was organized in January 1962. According to BuSandA Instruction 5450.86, its mission is:

"To monitor, coordinate and review the performance of the Navy Supply System...... insure responsive support to the Navy Supply System by the Defense Supply Agency Supply Centers; coordinate inventory control points' efforts in the preparation and publication of coordinated and consolidated allowance and load lists..; exercise retail supply management of Navy-owned stocks of Defense Supply Agency controlled material."

The foregoing suggests that FMSO will be in a position to exert strong, centralized direction and control over much of the Navy supply system. Present indications are that FMSO is not moving in this direction although it is still too early to evaluate what will actually be accomplished.

I. Afloat Developments

Recent developments which may affect logistics communications and data processing outside of CONUS have been discussed in earlier working papers by Dunlap and Associates, Inc., (particularly Working Paper No. 5, entitled Alternative Communications and Data Processing Designs for the Afloat Logistics System (U), 30 April 1962, CONFIDENTIAL, and Working Paper No. 1, entitled Data Processing and Communications Aspects of the Navy Logistic System, 31 December 1961, UNCLASSIFIED). Those discussions will not be repeated here. However, it should be noted that there is a strong trend toward increased use of high-speed data communications and automatic data processing equipment in those portions of the Navy logistics system which are outside of CONUS. In particular:

1. During the last three years EAM equipment has been installed aboard many mobile support ships[1] for supply purposes. During the next few years it is likely that additional mobile support ships, and possibly some submarines, will be provided with such equipment. In the future, small multiple-purpose computers similar to the AN/UYK-1 may be installed aboard mobile support ships and submarines and may be used for supply purposes. Also, larger multiple-purpose computers being installed aboard surface combatant ships, such as the AN/USQ-20 of the Naval Tactical Data System (NTDS), probably will be used for supply data processing. All of these computers are capable of producing supply data in machinable form for transmittal to CONUS.

[1] The term, "mobile support ships," as used herein includes tenders.

2. Currently, the Rapid Data Transmission System (RDTS) is being used to transmit resupply requirements from certain mobile support ships and overseas stock points to CONUS supply activities via teletype tape. This system probably will be extended to additional ships and stock points.

3. The radio communications equipment being developed for NTDS may be used to transmit supply data between ships in a task force.

4. The data processing capabilities of Operations Control Centers (OPCONCENTERS) at Kunia, Hawaii, at Norfolk, Virginia, and at the Navy Information Center (NAVIC) in Washington, D.C., are being developed at a rapid rate in order to rapidly collect, process, store, and disseminate tactical, strategic, and logistics information relating to naval operations. The facility at NAVIC will feed information to the command center of the Joint Chiefs of Staffs as well as to CNO.

III. DESCRIPTION OF ALTERNATIVE DESIGNS

A. General

This working paper considers two alternative designs for the communications and data processing portion of the Navy supply system in CONUS. Of course, many other alternatives could be considered. However, it is felt that the two designs considered herein are the most deserving of evaluation at this time. The two designs are radically different and should be regarded as representing two different families of alternative designs.

The first alternative design considered is the present communications and data processing system extrapolated to reflect current Navy plans and trends. Basically, it consists of automatic data processing equipment at all major stock points, ICP's, etc., with the supply activities interconnected by the SCAN system. The second is an integrated data processing system[1] consisting of two large central data processing sites with input/output equipment located at stock points, ICP's, etc. A communications network interconnects the input/output equipment with the equipment at the data processing sites such that all equipment can operate on-line.[2]

In this paper only the general characteristics of the alternatives are described, since detailed description is not required to permit crude evaluation of the alternatives. If either or both of the alternatives appear promising, their characteristics will be specified and evaluated in greater detail during a later stage of the research.

Figures 1 and 2 show schematic diagrams of Alternatives 1 and 2 respectively. The diagrams are greatly simplified. They are intended to

---

1 The term, "integrated data processing system," as used herein, means a system designed as a whole so that data are recorded at the point of origin in a form suitable for subsequent processing without any human copying.

2 The term, "on-line equipment," as used herein, means equipment for which the transfer of data to or from the unit is under direction of the control unit of the computer.

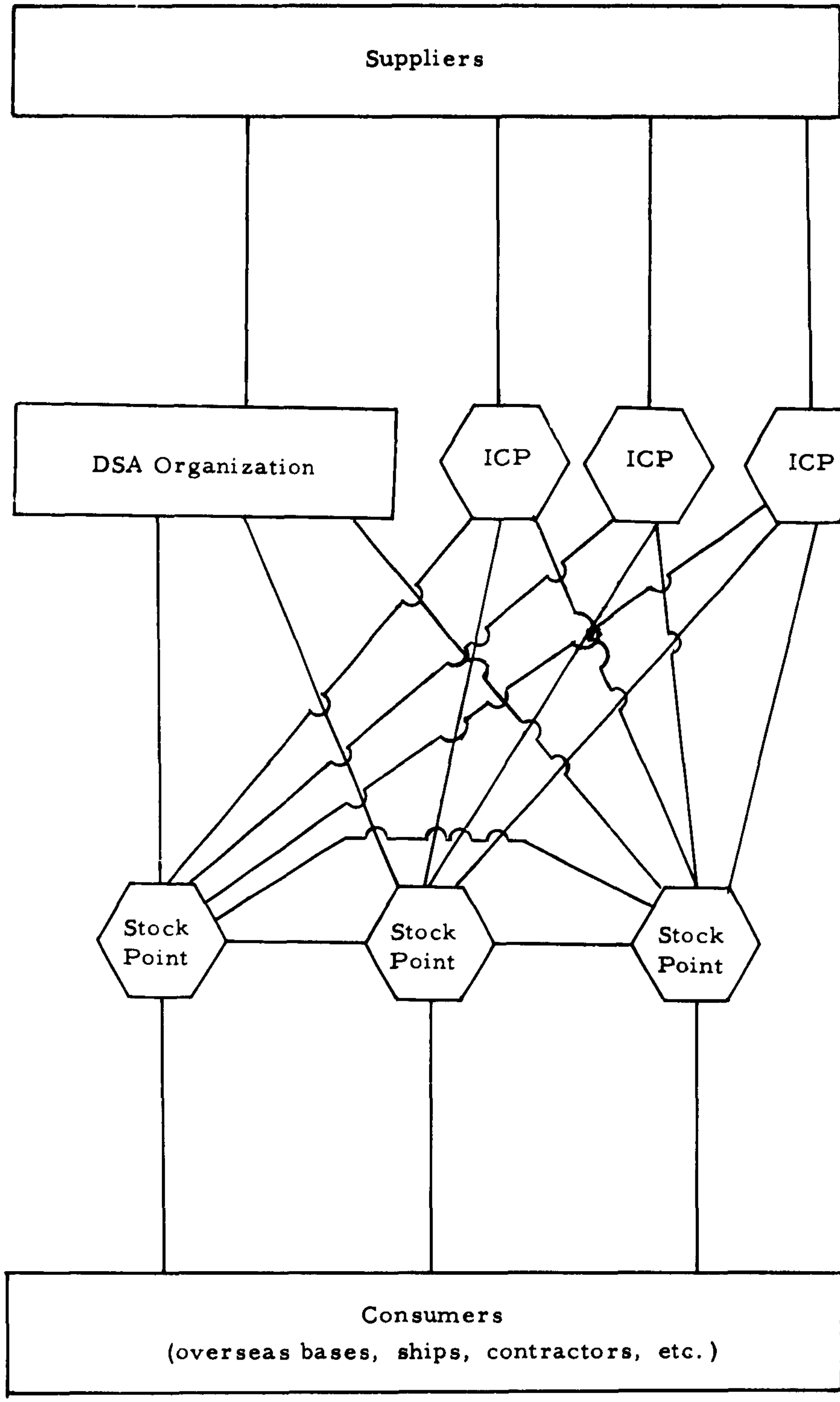

Figure 1 - Schematic Diagram of Alternative 1

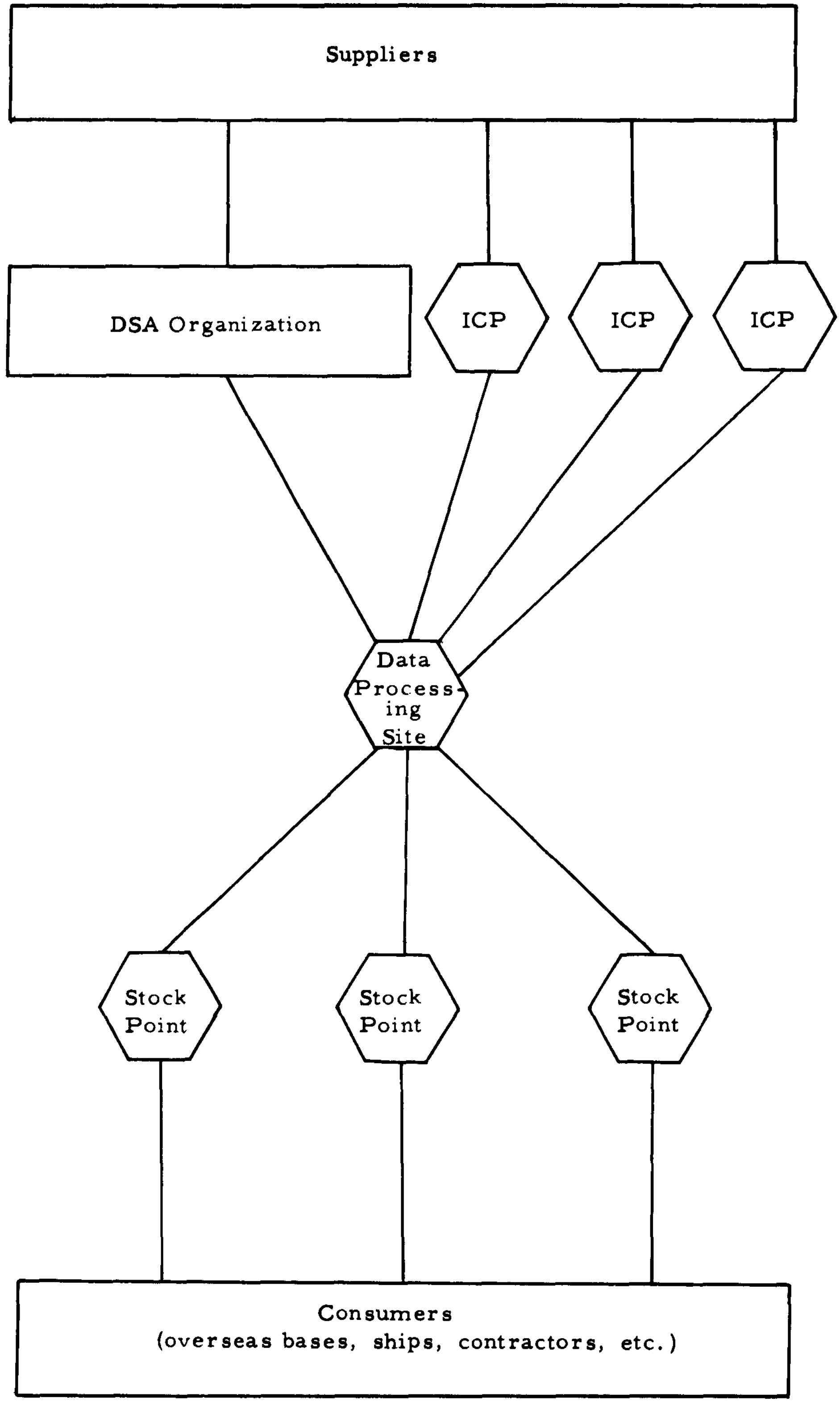

Figure 2 - Schematic Diagram of Alternative 2

aid the reader in understanding the description of the alternative which follows. In the diagrams, the principal activities in the Navy CONUS supply system (i.e., stock points, ICP's, and the central data processing sites) are represented by hexagons. Suppliers to the Navy supply system, the DSA organization, and customers of the Navy supply system in CONUS are represented by boxes. Lines connecting the symbols represent the principal channels of communication used for routine information (requisitions, follow-ups, etc.). As shown in Figure 1, under Alternative 1 requisitions on a stock point may be forwarded to another stock point, to any of the ICP's, or to DSA, depending upon the nature of the requisitions. As shown in Figure 2, Alternative 2 is similar to Alternative 1 except that there is a central data processing site. All routine information is channeled to or from this site. This results in a communications pattern that is much simpler than the one in Alternative 1.

B. Alternative 1

Alternative 1 is the present communications and data processing system extrapolated to reflect current Navy plans and trends which are likely to modify the system. The present system has been described in previous working papers by Dunlap and Associates, Inc., (particularly Working Paper No. 1 entitled, Data Processing and Communications Aspects of the Navy Logistics System, 31 December 1961). Current Navy plans and trends which are likely to modify the system are described in Part II of this paper.

Essentially, Alternative 1 consists of decentralized data processing operations. The various stock points, ICP's, etc., use different kinds of equipment. Some data processing is done with electronic data processing (EDP) equipment, some is done with EAM equipment, and some is done manually. Many of the computers at stock points, particularly those at the shipyards and at some of the air stations, are used for a variety of applications in addition to inventory and supply. Also, the operating procedures and decision rules employed by the various supply activities are different, although this will be changed somewhat by the programs for uniform data processing systems at stock points and at ICP's (see Part II, Section G, of this paper).

All major supply activities are interconnected by SCAN[1] (see Part II, Section F, of this paper). Most supply data are communicated over this

[1] The nature of the alternative would not be changed significantly if AUTODEN replaced SCAN.

system in MILSTRIP format. Other supply data are communicated via mail and telephone. The communications media used depend upon the facilities of the activities served and the type and priority of the messages to be transmitted.

The routing centers at the DSA distribution centers are the principal points of contact between the communications and data processing system of the Navy and that of DSA. The SCAN system interconnects most of the principal Navy supply activities with the routing centers. Thus, requisitions, supply directives, cancellations, follow-ups, referral orders, shipment cards, and other normal messages concerning DSA controlled materials are communicated via SCAN in MILSTRIP format. Navy stock points which are not served either directly or indirectly by SCAN communicate with the routing centers via mail. However, such stock points are small and insignificant. Navy stock points designated as direct supply support points for certain DSA defense supply centers communicate directly with those centers via SCAN.

Certain designated CONUS supply centers continue to be the principal points of contact between overseas bases and ships and the CONUS communications and data processing system. Requisitions, cancellations, follow-ups, and other normal messages are communicated in MILSTRIP format. Certain overseas stock points and mobile support ships transmit supply information to the CONUS supply centers via RDTS (teletype tape). Other overseas activities and ships communicate supply information to CONUS via mail. Emergency messages are transmitted via radio. Messages from overseas bases and ships which require action by inventory managers are communicated from the supply centers to the appropriate ICP's or DSA routing centers via SCAN.

C. Alternative 2

Alternative 2 consists of two large centralized data processing sites with supply activities connected to the data processing sites by a communication network that enables the entire system to operate in an integrated, on-line fashion. Previous research by the Teleregister Corporation has indicated that such a system is feasible using currently available technology and hardware.[1]

[1] Integrated On-Line Systems Approach to Navy Supply Operations, July 14, 1961, prepared under the direction of the Systems Research Division, Bureau of Supplies and Accounts, Contract No. Nonr 3408(00).

The two data processing sites are complete duplicates, operate in parallel, and are located at a distance sufficiently apart to reduce the danger of simultaneous destruction from enemy attack. (Variants of this involving only one data processing site or involving two or three nonduplicate, regional data processing sites may also be worth considering.) The sites are equipped with EDP machines and associated peripheral equipment such as interface buffers, and appropriate memory devices. They perform all supply data processing functions, including those associated with maintaining inventory records at stock points; processing customer and management inquiries; issuing of picking, packing, and shipping instructions; and procurement-receipt operations of ICP's.

Input/output equipment, consisting of printers, keyboards, punches, readers, etc., are situated at convenient user locations at stock points, management control points, ICP's, and customer locations at CONUS. These input/output stations are connected to the data processing site by a communications network consisting of full duplex lines.[1] Line concentrators and buffers are used to eliminate message interference between two or more stations served by the same lines.

Transactions (inquiries, requisitions, receipts, reconciliations, etc.) are entered at random into the system in MILSTRIP format through the remote input/output devices. Each transaction is automatically transmitted to the data processing site where, according to its type and content, files are searched, processed, and updated, and action messages are generated and transmitted. The originator is notified almost instantaneously of the action taken on his transaction. The system operates on a 24-hour-per-day basis, giving users and management immediate access to the total supply situation at all times.

The data processing sites handle some workloads on-line and some workloads off-line. All customer requisitions and requisition replies, availability inquiries, requisition follow-up inquiries, due-in messages from ICP's, receipt messages from stock points, and management inquiries are processed on-line. Reconciliations, INSMAT messages, and miscellaneous messages are partially processed on-line and then recorded on magnetic tape (or other storage type memory) for off-line completion. Certain operations directly

[1] Full duplex lines are, in effect, two telephone lines making possible simultaneous transmission and reception of data.

associated with the stock control functions, such as consolidation and invoice preparation for nonimmediate issues and reconciliation posting, are processed off-line. Other off-line data processing functions include those associated with accounting, procurement, payroll, transportation requirement and workload scheduling, management report preparation, allowance and load list preparation, and maintenance of stock lists.

Since in Alternative 2, all, or virtually all, of the automatic data processing operations currently performed at ICP's and at supply centers and depots in CONUS are performed at the central data processing sites, data processing facilities at ICP's and at supply centers and depots are no longer required. Shipyards and other stock points which presently have data processing facilities for major nonsupply applications continue to have such facilities in Alternative 2. However, the size and cost of these facilities are reduced because they are no longer used for inventory and supply purposes.

The central data processing sites serve as the principal points of contact between the communications and data processing system of the Navy and that of DSA. All messages to and from Navy stock points (including direct supply support points) concerning DSA controlled (as well as Navy controlled) materials are channeled through the central data processing sites. DSA defense supply centers are linked to the Navy data processing sites by the Navy communications network. Thus, requisitions, cancellations, follow-ups, referral orders, shipment cards, and other normal messages concerning DSA controlled materials are processed by the Navy data processing sites and are transmitted directly to and from the DSA defense supply centers on an on-line basis. Such communications are in MILSTRIP format.

From the standpoint of the DSA defense supply centers, the Navy data processing sites may be analogous to the DSA routing centers. Messages concerning items for the Navy may possibly be communicated directly to and from the Navy data processing sites rather than through the DSA routing centers. Thus the DSA routing centers may be bypassed. Of course, modifications of the above design which involve the routing of messages between the Navy and the DSA defense supply centers through the DSA routing centers can be considered.

Certain designated CONUS supply centers continue to be the principal points of contact between overseas bases and ships and the CONUS communications and data processing system. Requisitions, cancellations, follow-ups, and other normal messages are communicated in MILSTRIP format. Certain overseas stock points and mobile support ships transmit supply information to the CONUS supply centers via RDTS (teletype tape). Other overseas activities and ships communicate supply information to CONUS via mail. Emergency messages are transmitted via radio.

When messages from overseas bases and ships reach the CONUS supply centers, they are forwarded to the central data processing sites via the communications network. Since all messages are in MILSTRIP format, there is no problem in converting to machine language. Thus, the forwarding of most messages involves very little manual effort at the supply centers.

IV. COMPARISON OF ALTERNATIVE DESIGNS

A. Payoffs

In this part of the paper the consequences that would result from the adoption of Alternative 1 or Alternative 2 are estimated and compared; that is, this portion of the working paper is concerned with comparing the payoffs that are likely to result from the two alternatives described in Part III.

There are many indicators of payoff. In choosing between alternatives it is desirable to look at all of the indicators of payoff which are considered to be important. The alternative which appears to yield the most favorable combination of payoffs is, by definition, the best of those studied.

In what follows Alternatives 1 and 2 are compared in terms of many different indicators of payoff. Insofar as is practicable, quantitative measures of payoff are used. The indicators of payoff are classified into two general groups, namely, "dollar costs" and "performance." Section B is concerned with dollar costs, whereas Section C is concerned with performance. The results are summarized in Section D.

The comparisons described below are, in most cases, crude. However, three specific indicators of payoff have been studied in some detail. These more detailed studies are only briefly mentioned below, but are fully described in Appendices I, II, and III. It is anticipated that future research will include more detailed comparisons of Alternatives 1 and 2 in terms of other indicators of payoff.

In interpreting the discussions below, it should be remembered that Alternatives 1 and 2 pertain only to the CONUS logistics communications and data processing system. The rest of the Navy logistics system is assumed to be the same as it is at present. Changes in other characteristics of the logistics system may influence the payoffs described below. Thus, the comparisons made herein are not necessarily valid if changes are also made in other aspects of the logistics system.

B. Dollar Costs

The principal classes of dollar costs which are likely to be different, depending upon whether Alternative 1 or 2 is chosen, are described below:

1. Equipment costs. Equipment costs are considered to be the costs for the use, maintenance, and repair of all communications and data processing equipment in the CONUS logistics system, expressed on the basis of annual rental charges. Appendix 1 derives the estimated differences in equipment costs under Alternatives 1 and 2, for two different sets of assumptions. Whether equipment costs are lower under Alternative 1 or Alternative 2 depends upon which set of assumptions is chosen. In either case the equipment cost difference is not more than a few million dollars per year, which is small in relation to other kinds of cost differences. Thus, it is concluded that the differences in equipment costs are not likely to be a major consideration in the decision as to whether to adopt Alternative 1 or 2.[1]

2. Personnel costs. The differences in personnel costs under Alternative 1 and Alternative 2 are estimated in Appendix II. It is concluded that Alternative 2 would result in at least 2,763 fewer people than Alternative 1, and this would represent at least $21.1 million. Furthermore, these estimates are considered to be very conservative. The actual advantage of Alternative 2 in personnel costs is likely to be much greater than $21.1 million.

Most of the differences in personnel costs estimated in Appendix II rest on the assumption that under Alternative 2 certain supply functions at stock points and ICP's will be automated, and that under Alternative 1 these functions will not be automated. An objection to this assumption may be raised on the grounds that these functions may be automated under Alternative 1 through the uniform data processing systems for stock points and ICP's. In this paper it is assumed that the uniform data processing systems will not result in very much automation of functions which are now performed manually. BuSandA's plans appear rather vague as to what functions will and will not be automated at what stock points and ICP's and what changes in costs are likely to result therefrom. Also, at the present time there are no firm plans to use the systems at activities other than those managed by BuSandA. Of course, if many of the functions now performed manually at stock points and ICP's were automated through the uniform data processing systems, personnel costs would decline under Alternative 1. This would be partially offset by

[1] Note, however, that this statement would not apply if Alternative 1 is substantially modified, as for example by increasing the automation of decentralized activities. See the discussion under "Personnel Costs."

increases in the costs of data processing equipment rentals and or personnel involved in operating this equipment. Thus, the net effects would be to reduce the estimated advantage of Alternative 2 over Alternative 1 in personnel costs, but to increase the advantage of Alternative 2 in equipment costs.

3. Transportation and Inventory Costs

Without changing the level or levels of effectiveness at each installation, it is possible to trade inventory dollars for transportation dollars, at least within limits. In effect, effectiveness may be maintained with a cut in inventory by shifting stock from locations of comparative excess to locations of comparative shortage, as such excesses and shortages develop. Such redistribution can be carried to extremes, of course, in which case inventory costs or transportation costs will be excessive. There is some redistribution procedure which will minimize the sum of transportation and inventory costs for given levels of effectiveness.

Now it so happens that the redistribution procedures or rules which are feasible with Alternative 2 include all of the rules which are feasible with Alternative 1, plus others which are not feasible with Alternative 1. At the worst, therefore, transportation and inventory costs could be no higher with Alternative 2 than with Alternative 1. Actually a somewhat stronger statement can be made. The fact is that Alternative 2 makes it feasible to treat stock points as entities, in their relations both with each other and with suppliers. In consequence it should be possible to achieve gains via better planning and scheduling of redistributions so as to take advantage of consolidations across cogs.[1]

The foregoing statement is, of course, predicated on the assumption of similar performance in the two systems. Usually it turns out, however, that performance gains can be transformed into cost reductions, or vice versa,

---

[1] It may help the reader to gain an insight into the question of the magnitude of the potential gains from these sources if it is recalled that, in Working Paper No. 2, it was estimated that the Navy transportation costs of inland shipments, excluding household goods, during fiscal year 1961 was $61 million, while as of June 30, 1961, the Navy inventory of stock funded items alone was in excess of $1.5 billion.

according to the wishes of management. Hence, the gains in performance with Alternative 2 (discussed below in Section C) may be wholly or partially transformed into inventory cost reductions if so desired, despite the statements above.

C. Performance

The differences in the principal aspects of logistics performance under Alternatives 1 and 2 are discussed below:

1. Elapsed times. The time intervals that elapse between the submission of requisitions to Navy stock points and the issuance of materials by the stock points to satisfy those requisitions are called elapsed times. Elapsed times differ widely depending on the particular types of situations (types and priorities of requisitions; requisitions for in-stock, not-in-stock, and non-stocked items; type of materials; etc.). In any case, elapsed times are highly important measures of the performance of the CONUS logistics system.[1]

Appendix III discusses the differences in elapsed times under Alternatives 1 and 2. Average elapsed times under both alternatives are estimated for many representative situations that are likely to occur frequently. These times are much lower under Alternative 2 than under Alternative 1. It is concluded that elapsed times for virtually all of the more frequently encountered situations would be considerably lower under Alternative 2 than under Alternative 1.

The percentage of requisitions that are filled from stock is an important determinant of the average elapsed time involved in filling all requisition This percentage is routinely measured by the Navy and is called "supply effectiveness." The Navy employs several different measures of supply effectiveness, including gross effectiveness, net effectiveness, effectiveness of particular stock points, and system wide effectiveness. These measures influence and are influenced by a number of factors. For example, as the

[1] For a discussion of this point see OW Notes #9, Assistant Chief for Research and Development, Bureau of Supplies and Accounts, 3 August 1962.

percentage of requisitions that are filled from stock goes up, the number of procurements for end use and the number of follow-ups decline, which tends to reduce operating costs. As redistribution decisions rules are modified to permit more, or more effective, redistributions or as inventory levels go up, the percentage of requisitions that are filled from stock tends to increase.

As has been previously stated, elapsed times for most types of requisitions would be considerably lower under Alternative 2 than under Alternative 1. Implicit in this statement, and in Appendix III, is the assumption that inventory levels would be the same under the two alternatives. However, Navy management might decide to forego the improvement in performance and take the benefits in the form of lower costs. This could be accomplished by reducing inventories and, therefore, inventory costs to the point, say, at which the average elapsed time involved in filling all requisitions is the same under the two alternatives. The same kind of choice exists, of course, if supply effectiveness is stressed rather than elapsed time. It is true, in addition, that the gains can be taken in more complex ways.

For example, the percentage of requisitions that are filled from stock can be held the same under both alternatives, in which case the gains under Alternative 2 can be taken in the form of reduced elapsed times for requisitions not met from stock, or in the form of lower costs, or some combination of the two.

2. Reliability and vulnerability. Reliability, as the term is used herein, refers to the likelihood of equipment breakdowns and the ability of the logistics system to operate in the event of such breakdowns. Vulnerability is a special case of reliability. It refers to the likelihood of equipment breakdowns caused by military action of an enemy and the ability of the logistics system to operate after such an attack.

It is very difficult to draw general conclusions about the relative reliability and vulnerability of the two alternatives at this time. The reliability of the systems cannot really be estimated until the characteristics of the particular equipment to be used are known. Of course, the equipment has not been selected as yet. The vulnerability of the systems depend upon such factors as the nature of an enemy attack, what targets are selected, what weapons are employed, and the nature of the defense.

Nevertheless, it appears as if Alternative 2 does have a major advantage over Alternative 1 in terms of reliability and vulnerability. This is because under Alternative 1 there is very little data processing equipment that is not used in the normal operation of the system. Thus, any breakdown in data processing equipment is likely to cause delays in processing and, possibly, may resort in manual methods of processing. However, under Alternative 2 there are two complete, duplicate data processing installations at different locations which operate in parallel. Moreover, each installation has more computational and peripheral equipment than is required to perform its normal functions. Thus, the system could operate without any degradation in performance even if there were a complete equipment breakdown at one site and a partial equipment breakdown at the other site. Finally, the comparatively centralized data processing system of Alternative 2 makes it much cheaper to consider hardened sites if vulnerability is an important aspect of the problem.

A potentially important offsetting characteristic arises from the fact that some strategics and weapons could be employed by the enemy which would make Alternative 1 preferable with respect to vulnerability. If Alternative 2 involved unhardened sites, the enemy could do more damage with a small number of bombs on target than under Alternative 1.

3. Quality of command decisions. Alternative 2 appears to have advantages over Alternative 1 on the basis of the quality of the military command decisions that would result therefrom. Under Alternative 2 all data on current stock levels, demand rates, etc., at CONUS stock points would be maintained at one central location. This would facilitate the collection of supply status information which may serve as useful inputs to strategic decisions. It is, in fact, rather difficult to see how the Navy can properly discharge its military responsibilities without up-to-date and accurate information on the status and disposition of all of the resources at its disposal. This includes not only information on the state of readiness of ships, their number, location, and so on, but also analogous information on the important items of logistic support. Alternative 2 may therefore be more compatible with the Command and Control systems of the future.

4. Other aspects of performance. There are many other aspects of performance which are important in the logistics system. However, these other performance aspects are not expected to differ significantly as between Alternatives 1 and 2.

For example, the flexibility of the logistics system to adjust and to operate effectively in a changing environment (changes in types of warfare, weapons systems, political alignments, etc.) is an important aspect of performance. Also error rates are important aspects of performance.

However, both alternatives seem to provide reasonable flexibility and errors are not expected to be a major problem under either alternative. In any case, there does not appear to be any basis for discriminating between the alternatives on these grounds.

D. Summary

In summary, the relatively crude comparisons of the alternatives given above indicate that Alternative 2 is much more desirable than Alternative 1. It appears that Alternative 2 would result in some combination of lower costs and better performance.

In particular, in the absence of any particular policy changes, Alternative 2 would result in much lower personnel costs than would Alternative 1. It is expected that there would also be savings in transportation costs and/or inventory holding costs. Equipment costs would be approximately equal under the two alternatives.

Similarly, without any particular policy changes designed to alter the the form in which gains are taken, the performance of the CONUS logistics system would be much better under Alternative 2 than under Alternative 1. Elapsed times would be much lower under Alternative 2. Also, Alternative 2 has advantages in terms of the reliability of the equipment, in terms of the vulnerability of the system to some kinds of enemy attack, and in the quality of strategic decisions. There appears to be little or no difference between the alternatives in terms of other aspects of performance such as flexibility and error rates.

V. IMPLEMENTATION

A. General

The preceding part of this working paper compared Alternatives 1 and 2 in terms of costs and performance. It was concluded that Alternative 2 appears to be much more desirable. However, thus far nothing has been said with respect to the feasibility of implementing Alternative 2. The implementation of Alternative 1 should not present a major problem, since it is basically the current communications and data processing system extrapolated to reflect current Navy plans and trends. However, since Alternative 2 represents a substantial departure from the present system, the feasibility of its implementation is not obvious.

This part of the paper describes one procedure for implementing Alternative 2. There may be better methods of implementation. However, the method described below is, at least, feasible. It consists of two successive phases, called a "study" phase and an "action" phase. These phases are described, respectively, in Sections B and C.

The study phase involves the detailed design, specification, and evaluation of the communications and data processing system in Alternative 2. The Navy could postpone a definite decision to proceed with Alternative 2 until the study phase is completed. If, at that time, Alternative 2 still appears to be desirable the Navy would proceed with the action phase. This consists of ordering and installing equipment, converting to the new system, and disposing of the portions of the old system which are no longer required.

B. Study Phase

The first step of the study phase is the establishment of a group within the Navy to design and evaluate in detail a centralized, integrated data processing system along the lines of Alternative 2. The group would include representatives from several Navy bureaus and offices. However, it would be largely staffed by representatives of BuSandA. The group would have a sizeable research staff of its own and should be able to call on outside consultants when necessary.

The study group suggested above would be concerned with the detailed design and evaluation of the new communications and data processing system in CONUS. A great many areas would need to be examined. Some of the questions that need to be investigated are listed below. This list is not exhaustive; it merely indicates the scope of the analysis that is required:

1. What functions should be performed at the central data processing site?

   a. What ICP functions should be performed?

   b. What stock point functions should be performed?

   c. What BuSandA functions should be performed?

   d. What reports should be routinely prepared for management?

2. What should be the general physical design of the communications and data processing system?

   a. Which stock points should be directly served by the system?

   b. How many data processing sites should there be? Should they be nonduplicate regional sites or should they be duplicate sites operating in parallel? Where should they be located?

   c. How should the data processing sites be constructed? Should at least one of the sites be located underground and hardened?

   d. What should be the nature of the communications system? What should be the configuration of the communications network?

3. What processing procedures should be employed?

   a. How should requisitions be prepared for entry into the system?

   b. How should inquiries be prepared for entry into the system?

   c. How should technical files be maintained and edited?

d. What information should be exchanged between the data processing sites and ICP's?

e. How should information be coded on various kinds of documents?

4. What decision rules should be used at the data processing sites?

   a. How should redistributions be scheduled?

   b. How should consolidations be determined?

   c. How should work be allocated among stock points?

   d. How should purchase quantities be calculated?

5. What should be accomplished on-line?

   a. What messages should be entered into the system on-line?

   b. How should messages entered into the system off-line be scheduled?

   c. What should be processed on-line at the data processing sites?

6. What data processing equipment, peripheral equipment, and terminal input/output equipment should be used?

   a. What should be the inventory record length and the method of storage and retrieval?

   b. What should be the anticipated rate of growth in the use of the system?

   c. How much fallback should be provided?

   d. What should be the specifications of the equipment?

   e. What equipment should be ordered and in what quantities?

7. How should the Navy CONUS communications and data processing system be integrated with external elements?

   a. What should be the relationship with DSA?

   b. What should be the relationship with overseas stock points?

   c. What should be the relationship with mobile support ships and with combatant ships?

8. How should the new system be phased in?

   a. How and when should the new procedures be implemented?

   b. How and when should the necessary personnel changes be made?

   c. What should be done with the facilities and equipments at stock points and ICP's that would no longer be required for supply purposes?

The answers to a few of these questions are assumed in the description of Alternative 2 contained in Part III of this paper. However, it is believed that they are worth re-examination. Some modification of the original description of Alternative 2 may be desirable.

Dunlap and Associates, Inc., will be studying many areas that pertain to the design of a future communications and data processing system in the course of future research. It is anticipated that these areas will include, for example, the advisability of a Navy consolidation of all inventory control points into one or two large activities, the desirability of major changes in the levels of inventory kept ashore and kept afloat, determination of number of stock points that should be directly served by an integrated communications and data processing system, and the general design of a fleet logistics communications and data processing system and its relationship to the CONUS system. All of these are broad, fundamental questions. The detailed design and evaluation of the communications and data processing system in CONUS, as exemplified by the above list of questions, are well beyond the scope of the current research effort.

When the analysis suggested above has been completed, the alternative communications and data processing systems should again be compared in terms of estimated costs and performance characteristics. At this point it should be relatively easy to make detailed comparisons. If Alternative 2 still appears to be the more desirable system, the Navy should proceed with the action phase.

It should be pointed out that, until this point is reached, the Navy will not need to spend much money on Alternative 2. Thus, it will have the option of discarding Alternative 2 without losing a substantial investment. However, after this point is reached, the Navy will be strongly committed to Alternative 2.

C. Action Phase

The next step is for the Navy to order and install the data processing and peripheral equipment, the communications lines, and the terminal equipment necessary for the operation of the system. Also, it must build or otherwise obtain facilities to house the central data processing installations. In other words, the Navy should obtain and install the physical facilities required for the operation of the system. In addition, it should prepare the necessary computer programs, instruction and procedures manuals, etc.

A major problem in the transition of the new system will be making the necessary personnel changes. Many of the people required for the operation of the new system might be obtained from the portions of the present system that will be phased out. Also, it may be necessary to hire some people from outside the Navy. These people will need to be relocated and to be given a training program. However, the new system will not be able to absorb all of the people at stock points and ICP's whose jobs will be eliminated. Total staffing of the supply system must be permitted to decline. This probably can be accomplished by failing to replace people who terminate voluntarily or for other normal reasons. Although making the necessary personnel changes will be difficult, the Navy constantly faces and successfully handles similar problems. The principal difference between this personnel problem and others is the number of activities which will be affected.

In order to make the transition from the present system to the new system as smooth as possible, it is suggested that the actual transition be spread out over a period of, perhaps, six months. This can be accomplished by dividing the functions to be performed at the central data processing sites into several groups. For example, one group might consist of the functions associated with inventory control and requisition processing. A second group might consist of the functions associated with the preparation of allowance and load lists. Each functional group would be transferred from the present system to the new system at a different time. The new system would not be given a new functional group until it was handling the functional groups already assigned to it reasonably well.

It is also suggested that the transfer of each group of functions from the present system to the new system be phased as follows. First, obtain the people necessary to perform the functions in the new system, and provide them with the necessary orientation and training. Second, begin performing the functions with the new system. Use the old system on a standby basis. Third, when the new system is performing the functions satisfactorily, discontinue use of the old system. This procedure should be repeated for each group of functions until the new system is fully operational. At that time the Navy can dispose of the portions of the old communications and data processing system which are no longer needed.

In summary, implementation of Alternative 2 is feasible. One method of implementation is outlined above. Other methods, or modifications of the method suggested above, may be preferable. In any event, the Navy should not have difficulty in developing an adequate implementation procedure.

VI. CONCLUSION

A. Summary

Two alternative designs for the communications and data processing portion of the Navy supply system in CONUS have been described and compared in terms of estimated costs and performance characteristics. The two designs were selected for investigation on the bases that they appeared to be promising and that they were substantially different from each other. However, both designs reflect current Defense Department trends toward standardization and centralization.

Alternative 1 is the present communications and data processing system extrapolated to reflect current Navy plans and trends. Basically, it consists of automatic data processing equipment at all major supply activities (stock points, ICP's, etc.) with the supply activities interconnected by the SCAN system. Alternative 2 is an integrated data processing system consisting of two large, central data processing sites operating in parallel, with input/output equipment located at stock points, ICP's, etc. A communications network interconnects the input/output equipment with the equipment at the data processing sites such that all equipment can operate on-line.

Alternatives 1 and 2 were compared in terms of many different indicators of payoff. Some of these comparisons were, necessarily, fairly crude. It was estimated that Alternative 2 would result in substantially lower costs than would Alternative 1. In particular, personnel costs would be much lower. Also, transportation and/or inventory costs probably would be lower under Alternative 2. Equipment costs would be about the same under both alternatives.

Also, it was estimated that the performance of the logistics system would be much better under Alternative 2 than under Alternative 1. Elapsed times would be much lower. Moreover, Alternative 2 has advantages in terms of the reliability of the equipment, in terms of the quality of strategic decisions, and perhaps also in terms of the vulnerability of the system to enemy attack. There appears to be little or no difference between the alternatives in terms of other aspects of performance such as flexibility and error rates.

Thus, on balance, Alternative 2 appears to be much more desirable than Alternative 1 in both cost and performance characteristics.

A procedure for implementing Alternative 2 was outlined. It consists of a "study" phase to be followed by an "action" phase. The study phase involves the detailed design, specification, and evaluation of the communications and data processing system in Alternative 2. It is quite possible that during the study phase desirable modifications of Alternative 2 will be found, and that the system that finally emerges will be an improvement over the design suggested herein. A firm decision to install a system along the lines of Alternative 2 would be deferred until the conclusion of the study phase. If, at that time, Alternative 2 still appears to be desirable the Navy would proceed with the action phase. This involves ordering and installing facilities and equipment, preparing computer programs, instruction manuals, etc., converting to the new system, and disposing of the portions of the old system which are no longer required.

B. Recommendations

Of course, the fact that Alternative 2 appears to be much more desirable than Alternative 1 does not necessarily mean that the Navy should proceed to implement Alternative 2. There is always a possibility that a radically different alternative will be found that is even better. Also, many very important considerations in the design of the future logistics communications and data processing system have not been discussed in this paper. Some of these considerations are currently being investigated by Dunlap and Associates, Inc., and by others. They include, for example, the nature of the DSA distribution system, the number of stock points and ICP's that the Navy should have, the nature of the future Navy logistics communications and data processing system at fleet and command levels, etc.

Rarely, if ever, is one in such a fortunate position that he knows all of the consequences that will result from a particular decision, so there is always some doubt about the proper course of action to take. People must take action in spite of the fact that their knowledge of the probable consequences is crude and incomplete, simply because they can't afford to wait until more information is available. The Navy is no exception. For example, in the very near future the Navy will have to make some basic decisions about how to adjust to DSA. In particular, it will have to determine who will control inventories of DSA furnished material at "retail" stock points, how to live within much more stringent stock fund constraints at certain industrial activities, etc.

Within the past year the Navy has taken many important actions. For example, it has decided to implement the uniform data processing system for stock points, it has started development of a uniform data processing system for ICP's, it has started to implement MILSTRIP, it has established the Fleet Material Support Office, etc. The Navy has made, and will continue to make, important decisions affecting the future logistics communications and data processing system in CONUS despite imperfect knowledge about the consequences of those decisions. The most that can be expected is that the best possible decisions will be made in light of currently available knowledge.

This paper has shown that Alternative 2 appears to be much more desirable than Alternative 1. Admittedly, many important factors have not been considered. However, it is felt that, in the main, consideration of such factors would tend to strengthen the case for Alternative 2. For example, Alternative 2 will help to resolve the current problem of controlling inventories of DSA furnished materials at "retail" stock points. Many people have suggested that the Navy's problems arising from the establishment of DSA, as well as from other sources, can best be solved by merging all Navy ICP's into one or two large ICP's. Dunlap and Associates, Inc., has developed additional evidence (as yet unpublished) which tends to support consolidation of all Navy ICP's. If such a development took place, the advantage of Alternative 2 over Alternative 1 would be much greater than has been indicated above.

In view of this and of the analysis contained in the body of this report, the following recommendations are made:

1. Current plans and trends indicate that during the next decade or so, the Navy is likely to have a communications and data processing system very similar to Alternative 1. However, Alternative 2 appears to be far more desirable. Accordingly, it is recommended that the Navy change its plans. It should tentatively plan to adopt an integrated communications and data processing system with centralized data processing, along the lines suggested by Alternative 2.

2. In order to avoid delay in implementing Alternative 2, it is recommended that the Navy begin the study phase, as suggested in Part V of this paper. The Navy should start as soon as possible by setting up a group responsible for conducting the studies. Although this group should include representatives from several Navy bureaus and offices, BuSandA should take the initiative in forming the group.

During the study phase, additional information which will be helpful in developing an improved communications and data processing system will become available to the study group. Such information may be expected from future research to be conducted by Dunlap and Associates, Inc., from research to be conducted by the study group itself, and from other sources both within and outside the Navy.

3. A firm decision to proceed with the implementation of Alternative 2 should await a recommendation to that effect from the proposed study group. Some time could be saved, no doubt, by proceeding to immediate implementation without such a group, but the fact is that detailed specification of Alternative 2 would impose delay in any case. It is believed that the planning carried out by such a group would result in improvement both in the implementation phases and in the ultimate design of the system.

APPENDICES

APPENDIX I

CALCULATION OF COMPARATIVE EQUIPMENT COSTS

A. General

The purpose of this appendix is to show how the differences in equipment costs between Alternative 1 and Alternative 2 were estimated. These cost estimates are very crude, and are intended merely to indicate the general magnitude of the differences in equipment costs that may be involved.

All equipment costs are stated in terms of annual rental costs. The rental costs include all charges for use, maintenance, and repair of the equipment.

In order to avoid ambiguity, two assumptions are made with respect to the portion of the logistics system that is served by the communications and data processing systems considered in Alternatives 1 and 2. First, it is assumed that the systems will serve only CONUS activities. CONUS is defined as consisting of the Continental United States excluding Alaska.

Second, it is assumed that the Navy logistics system is structured as it was during fiscal year 1961. Thus, the impact of DSA is ignored. Although the advent of DSA will have major effects on the Navy supply system, it should not have a major effect on the differences in equipment costs between Alternative 1 and Alternative 2.

The remainder of this appendix is concerned with the calculation procedures used to estimate the differences in equipment costs. The general procedure employed is as follows:

1. First, the gross annual rental expenditure for the communications and data processing equipment required in Alternative 2 is estimated.

2. Second, the gross annual rental expenditure for communications and data processing equipment which could be given up (if Alternative 2 were adopted) is estimated.

3. Third, the net rental cost (or net savings) from Alternative 2 is estimated by subtracting item 2 (above) from item 1 (above).

Section B of this appendix describes the first of the above steps. Sections C and D are concerned with step 2. The sections differ in the assumptions which are made. Section C assumes a "minimum" and Section D a "maximum" of equipment rendered unnecessary by the adoption of Alternative 2. Section E describes step 3 under each of the sets of assumptions for step 2.

B. Gross Rental Expenditure With Alternative 2

The gross annual rental expenditure for the communications and data processing equipment required in Alternative 2 may be estimated from the data presented in Integrated On-Line Systems Approach to Navy Supply Operations, 14 July 1961, prepared by The Teleregister Corporation under the direction of the System Research Division, BuSandA, under Contract No. Nonr. 3408(00). In this report equipment costs were estimated for several different communications and data processing systems, each of which was similar to the system described under Alternative 2. Each of the systems studied served 52 CONUS stock points. The study covered the functions of maintaining inventory records, processing customer requests for materials, processing customer and management inquiries; issuing of picking, packing, and shipping instructions and reconciling of these transactions with the associated records; and exchanging information between inventory records and ICP's concerning procurement-receipt operations.

The systems considered by the Teleregister Corporation differed in a number of respects. Some of the systems involved only one data processing site located near Norfolk. Other systems involved two duplicate processing sites operating in parallel, one located near Norfolk and one located about 100 miles away. One of the systems involved two nonduplicate regional processing sites, one located near Norfolk and one located near Oakland. Also, the systems differed in that some of them were equipped to handle all messages on-line, whereas others were equipped to handle on-line only those messages which pertain directly to requisitions, inquiries, and receipts. In addition, some of the systems were equipped to handle only 1960 peak traffic rates and some of the systems could handle double the 1960 peak traffic rates. Estimated annual rental costs for the communications and data processing equipment required in the various systems ranged from $5, 556, 000 to $15, 528, 000.

In the subsequent portions of this appendix, it will be assumed that the annual rental cost for the equipment required in Alternative 2 is $10,416,000. This is the Teleregister Corporation's estimate of the cost for a system involving two duplicate data processing sites operating in parallel and equipped to handle all messages on-line provided that traffic does not exceed the 1960 peak traffic rates.

C. Minimum Expenditure for Equipment Displaced by Alternative 2

In this section the minimum expenditure for communications and data processing equipment rental that might be avoided by the adoption of Alternative 2 is estimated. It is assumed that the only savings in data processing costs will be those rental costs which are currently incurred at CONUS stock points in order to process units of work which would be processed centrally on-line under Alternative 2. No allowance is made for any reduction in costs currently attributable to workloads that might be handled off-line under Alternative 2. Also no allowance is made for any possible reduction in costs incurred at ICP's.

The procedure used to estimate the "minimum gross savings" in communications and data processing equipment rental costs was as follows:

1. It was assumed that 52 stock points would be served by the system described in Alternative 2 and that these would be the same as the 52 stock points considered by the Teleregister Corporation (see Section B of this appendix) with the following exceptions:

   a. The Naval air station at Glynco, the Naval station at New Orleans, and the Naval supply depot at Clearfield would not be served.

   b. The Naval torpedo station at Keyport, the Naval ordnance test station at China Lake, and the Naval weapons station at Yorktown would be served.

The 52 stock points thereby selected were the 52 largest stock points in CONUS as ranked by "total demand requests, line items" for all activities and cogs of material as reported in NAVSANDA Publication 295 for the period, 1 April 1961 through 30 June 1961. The selected activities accounted for 91 per cent of all CONUS stock points listed in NAVSANDA Publication 295, and accounted for 99.97 per cent of all demand requests listed for CONUS stock points.

2. As a measure of the relative level of workload at each stock point which would be processed centrally on-line under Alternative 2 "total demand requests, line items" for all cogs of material for the period, 1 April 1961 through 30 June 1961, as reported in NAVSANDA Publication 295, was used.

3. Estimates of current automatic data processing equipment rental costs and man-years in data processing by type of equipment were obtained

for most of the stock points. The data used were the estimates for fiscal year 1962 submitted to the Navy Comptroller for budgetary purposes by various Navy bureaus and offices during August 1961.

4. Current annual automatic data processing rental costs attributable to workloads that would be processed centrally and on-line under Alternative 2 were estimated for a sample of eight supply centers and supply depots. They included the Naval supply centers at Bayonne, Norfolk, San Diego, Oakland, and Pearl Harbor and the Naval supply depots at Newport, Philadelphia, and Great Lakes. For each of these activities the work measurement report for fiscal year 1961 for EAM and ADPS operations was used in order to calculate:

a. The sum of the labor (basic labor plus overtime) cost in dollars charged to function numbers 134, 136, 202, 204, 205, 206, 211, 226, 241, 242, and 421.

b. The labor cost, in dollars, charged to all functions.

Then the ratio of a to b was calculated. (The resultant percentages ranged from 22 per cent to 64 per cent and averaged 50.5 per cent.) The ratio for each activity was multiplied by the rental cost for that activity (see 3, above) in order to obtain an estimate of the savings in rental costs that would result from Alternative 2.

5. Current annual automatic data processing rental expenditures attributable to workloads that would be processed centrally and on-line under Alternative 2 were estimated for a sample of four Naval shipyards and four Naval air stations. The shipyards were those located at Boston, Philadelphia, Mare Island, and Puget Sound, while the air stations were those located at Norfolk, Pensacola, North Island, and Alameda. Each of these activities was asked by letter to supply certain information on their data processing operations. A copy of one of the letters is shown in Figure A-1. On the basis of the answers received and the rental costs for each activity (see 3, above), the rental costs at each activity for equipment that could be given up (if Alternative 2 were adopted) were estimated.

6. For each of the activities sampled (see 4 and 5, above) these gross reductions in rental costs that would result if Alternative 2 were adopted were plotted against the measure of workload that would be processed centrally under Alternative 2 (see 2, above). The data are shown in Figures A-2, A-3, and A-4. Two conclusions were drawn from these data:

Figure A-1

FROM: Chief, Bureau of Supplies and Accounts
TO: Commander, Puget Sound Naval Shipyard, Bremerton, Washington
Commander, Mare Island Naval Shipyard, Vallejo, California
Commander, Philadelphia Naval Shipyard, Philadelphia 12, Penna.
Commander, Boston Naval Shipyard, Boston 29, Massachusetts

SUBJECT: Request for certain statistical estimates associated with EDP operations

1. The Bureau of Supplies and Accounts is attempting to estimate the total costs associated with operating the Navy Supply System by its different cost elements. One element which cannot be broken out and estimated in the Navy Department is the Electronic Data Processing (EDP) contribution to the supply function as opposed to all other efforts. In particular, the following two estimates are requested:

a. The percentage of total civilian plus military man-hours spent in processing (including Electronic Accounting Machine (EAM) and Electronic Data Processing Machine (EDPM) operations) data for "supply applications."

b. The percentage of total operating time of EDP computer equipment that is spent on "supply applications."

2. For this purpose, "supply applications" should be interpreted to include such functions as maintenance of records on dollars and quantities of inventory in the Supply Department, inventory control, receipt and issue control, purchasing, redistribution. It should not include such functions as shop store operation; plant accounting; timekeeping and payroll; disbursing; production planning; estimating and control; cost accounting.

3. If local records do not readily yield the data upon which to base an estimate, an estimate based on best judgment is requested.

H. F. MILLS
By direction

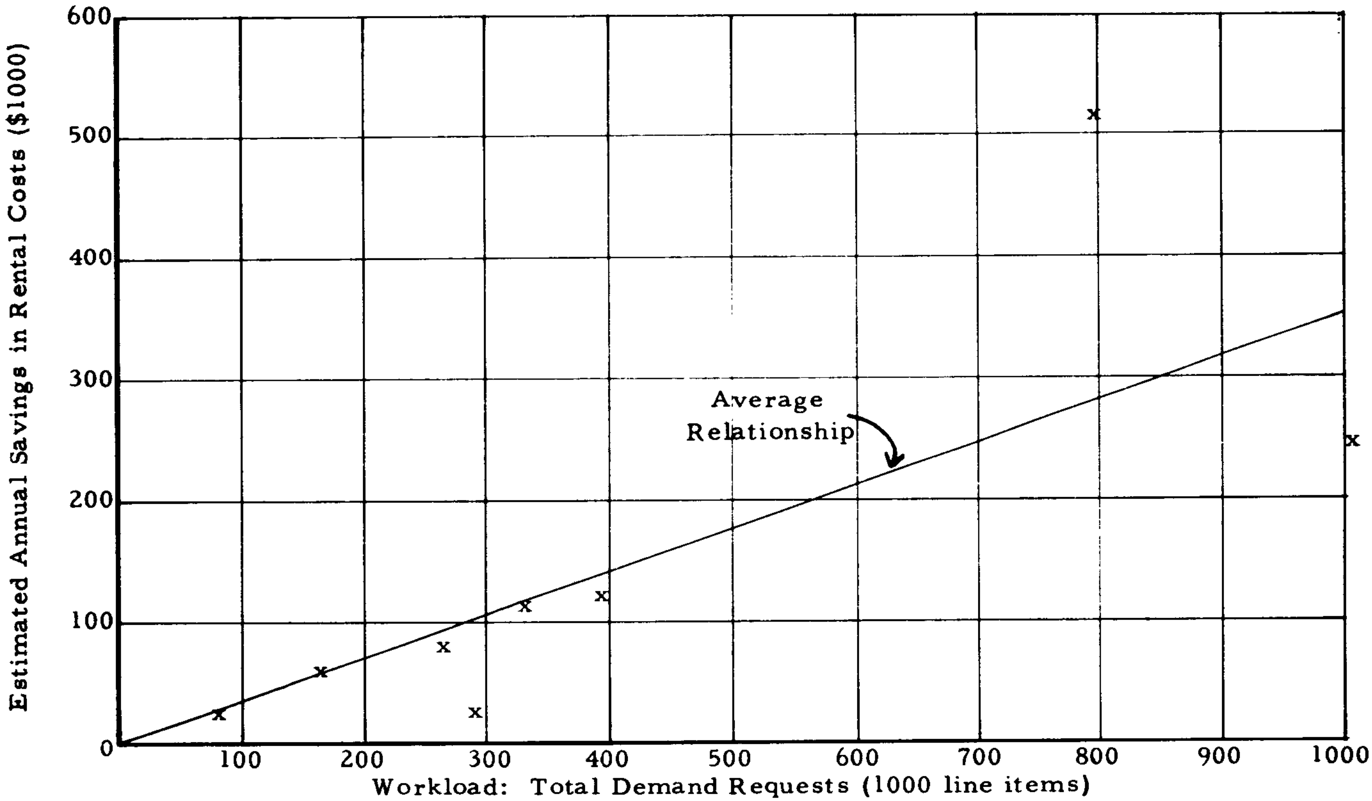

Figure A-2: Estimated Savings vs. Workloads at Supply Centers and Depots

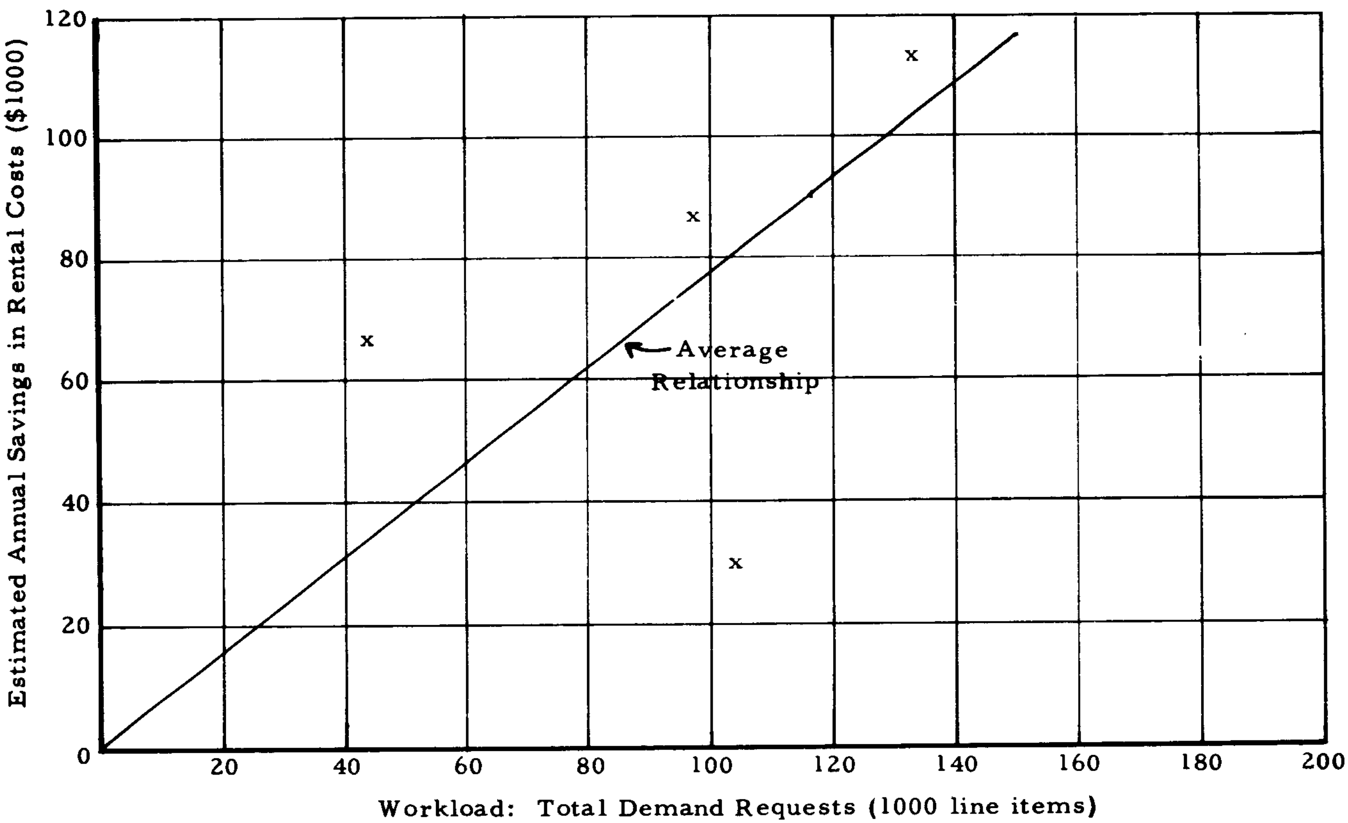

Figure A-3: Estimated Savings vs. Workloads at Shipyards

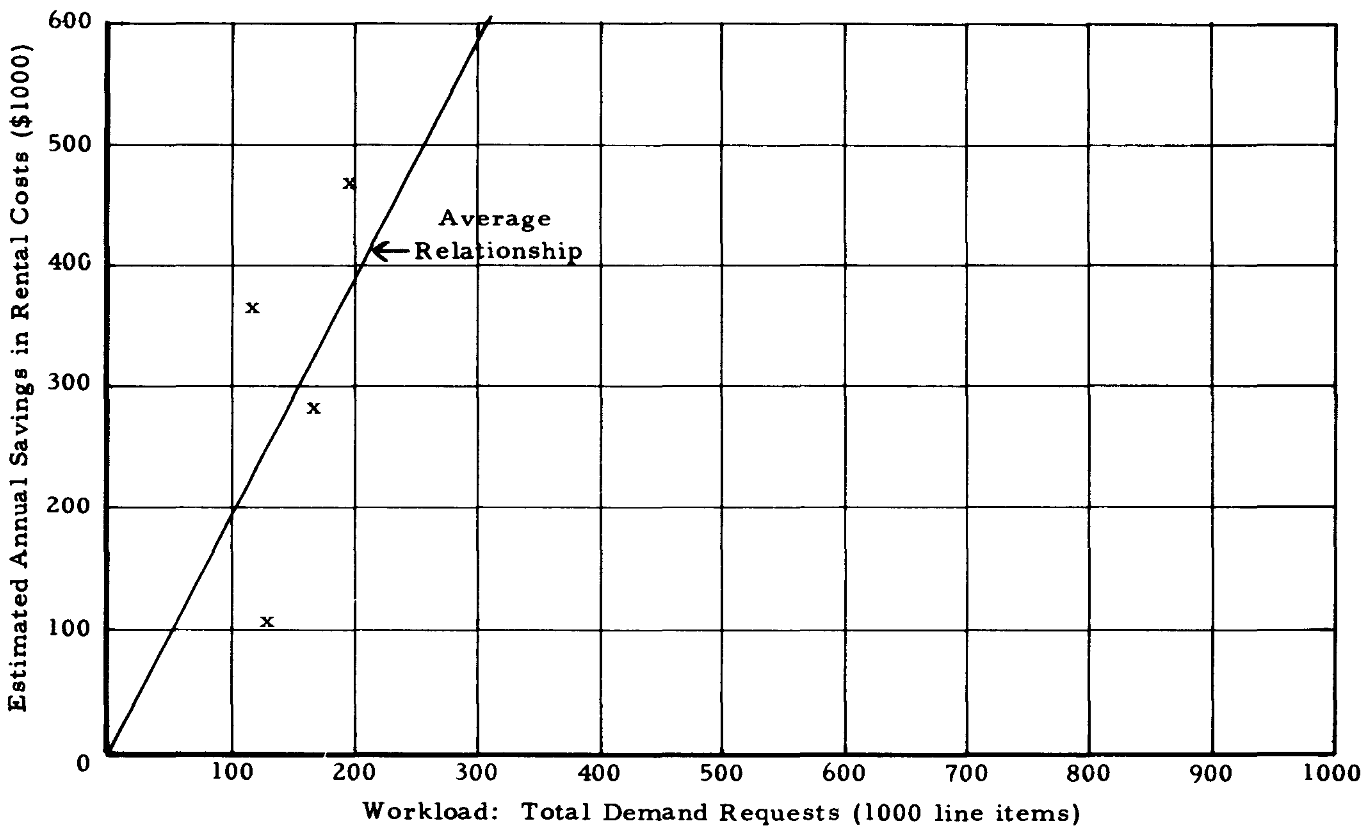

Figure A-4: Estimated Savings vs. Workloads at Air Stations

a. The relationships between gross reductions on rental expenditures and the measure of workload differ significantly between types of activities (i.e., supply centers and depots, shipyards, and air stations).

b. It is reasonable to assume that gross reductions in rental costs vary linearly with the measure of workload for any one type of activity.

The average annual gross reductions in rental cost per unit of workload (as measured by 2, above) were:

Supply centers and depots	$ 0.35497
Shipyards	0.78411
Air stations	1.9766

7. The 52 CONUS stock points which were assumed to be served by the system described in Alternative 2 (see 1 above) were classified into three groups designated as follows:

a. Supply centers and depots. This group consisted of all the CONUS BuSandA managed stock points, all of which were supply centers or supply depots.

b. Shipyards. This group consisted of all the BuShips managed shipyards and included NWP Washington.

c. Air Stations. This group consisted of all other stock points, including BuWeps managed stock points naval stations, Marine corps Air Stations, etc.

Then, the gross annual reductions in data processing equipment rental expenditures that would result from Alternative 2 were estimated as follows:

Stock Point Group Designation	Number of Stock Points	Total Workload (see 2 above)	Expenditure per Unit of Workload (see 6, above)	Gross Annual Reductic in Expenditures Col. (3) x Col. (4)
(1)	(2)	(3)	(4)	(5)
Centers and Depots	9	3,274,400	$0.35497	$1,162,300
Shipyards	12	1,283,900	0.78411	1,006,700
Air Stations	31	1,503,700	1.9766	2,972,200
Total	52	6,062,000		$5,141,200

8. It was assumed that the gross annual reductions in rental of communications equipment would be $1,058,000. This figure is the sum of $860,000, which is the estimated annual amount which the Navy pays to the Army as rental for use of SCAN lines, and $198,000, which is the Navy's current annual rental cost for SCAN terminal equipment.[1]

9. The estimated minimum gross reduction in expenditures for communications and data processing equipment rendered unnecessary by the adoption of Alternative 2 is the sum of the items shown in 7 and 8 (above), or $6,199,200.

D. Maximum Expenditure for Equipment Displaced by Alternative 2

In this section the "maximum" gross reduction in communications and data processing equipment rental expenditures that would result from Alternative 2 is estimated. All assumptions are identical to those in Section C of this appendix except that it is assumed that all data processing equipment rental expenditures which are currently incurred at BuSandA managed activities will be rendered unnecessary by Alternative 2. Thus, it is assumed that all data processing equipment rental costs incurred at supply centers and supply depots in CONUS, at ICP's, and at BuSandA in Washington, D.C., would be cut out. Units of work which need not be processed on-line would be handled off-line under the system described in Alternative 2. It is assumed that there would be no reduction in the data processing equipment rental expenditures incurred at non-BuSandA managed activities, except for those expenditures which are currently incurred at stock points in order to handle workloads which would be processed centrally on-line under Alternative 2.

The procedure used to estimate the maximum gross reduction in communications and data processing equipment rental expenditures was similar to the procedure described in Section C of this appendix except that the savings in data processing rental costs for BuSandA managed activities were estimated as follows:

[1] If AUTODEN replaced SCAN in Alternative 1, the estimated gross annual savings would be about $600,000 greater than that shown above. This is because it is estimated that AUTODEN would cost about $1,000 per month per terminal more than SCAN and that about 50 activities would be served.

1.	Total data processing costs for BuSandA managed activities		$8,926,200
	less: data processing costs at non-CONCUS activities:		
2.	NSC Pearl Harbor	$163,200	
3.	NSD Guantanamo Bay	34,800	
4.	NSD Guam	84,500	
5.	NSD Subic Bay	68,700	
6.	NSD Yokosuka	0	
7.	Subtotal		351,200
8.	Savings in data processing costs for BuSandA managed activities		$8,575,000

The data in lines 1 and 2 above are estimates for fiscal year 1962 submitted to the Navy Comptroller by BuSandA on 23 October 1961. The data on lines 3 through 6 are actual costs for the third quarter of fiscal year 1962, as obtained from the Inventory Control Division of BuSandA, converted to annual rates.

Thus, the estimated maximum gross expenditure for communications and data processing equipment to be displaced by Alternative 2 is:

Data processing equipment	
BuSandA managed activities (see above)	$8,575,000
Shipyards (see Section C, item 7)	1,006,700
Air stations (see Section C, item 7)	2,972,200
Subtotal	$12,553,900
Communications equipment (see Section C, item 8)	1,058,000
Total gross reduction in expenditure	$13,611,900

E. Net Costs

In Section B of this appendix, it was estimated that the gross annual rental cost for the communications and data processing equipment required in

Alternative 2 would be about $10.4 million. In Section C it was estimated that the minimum gross annual reduction in rental costs would be about $6.2 million. In Section D a maximum gross annual reduction of $13.6 million was estimated. Thus, it appears that there might be a net increase in annual equipment rental costs under Alternative 2 of $4.2 million, or a net reduction of as much as $3.2 million per year.[1]

Admittedly, the foregoing analysis is crude. Many of the underlying assumptions are open to question. However, it is felt that the foregoing analysis does justify the conclusion that the change in annual rental costs for communications and data processing equipment would not be more than a few million dollars, one way or the other. This change is not large enough to make equipment rental costs a deciding factor in determining whether the Navy should adopt the type of system described in Alternative 2.

---

[1] If AUTODEN replaced SCAN in Alternative 1, the estimated figures would be $3.6 million and $3.8 million, respectively.

APPENDIX II

CALCULATION OF COMPARATIVE PERSONNEL COSTS

A. General

The purpose of this appendix is to show how the differences in personnel costs between Alternative 1 and Alternative 2 were estimated. The cost estimates which are crude, are intended merely to indicate the general magnitude of the differences in personnel costs that may be involved.

In order to avoid ambiguity, two assumptions are made with respect to the portion of the logistics system that is served by the communications and data processing systems considered in Alternatives 1 and 2. They are identical to the assumptions made in Appendix I.

First, it is assumed that the systems will serve only CONUS activities. CONUS is defined as consisting of the Continental United States excluding Alaska.

Second, it is assumed that the Navy logistics system is structured as it was during fiscal year 1961. Thus, the impact of DSA is ignored. Although the advent of DSA will have major effects on the Navy supply system, it should not have a major effect on the differences in personnel costs between Alternative 1 and Alternative 2.

The remainder of this appendix is concerned with the calculation procedures used to estimate the differences in personnel costs. It is assumed that under Alternative 1 personnel levels will be the same as they are currently. Under Alternative 2, it is assumed that personnel levels will decline because of the automation of certain functions that are currently performed manually.

The appendix consists of five sections of which this is the first. Section B is concerned with changes in the number of people engaged in automatic data processing operations (i.e., the number of people in the data processing departments or divisions of Navy activities). It is concluded that Alternative 1 and Alternative 2 will not differ significantly in this respect.

Sections C and D show the estimated differences in the numbers of people involved in functions currently performed at stock points and ICP's excluding people engaged in automatic data processing operations. Section C is concerned with stock points, whereas Section D is concerned with ICP's. It is concluded that under Alternative 2 there would be major reductions in personnel levels at both types of activities because of the automation of certain operations associated with such functions as requisition processing, stock and inventory control, and accounting.

Section E shows what the estimated differences in numbers of people are likely to mean in dollars.

B. ADP Personnel

It will be assumed that the number of people engaged in automatic data processing (ADP) operations (i.e., the number of people in the data processing departments or divisions of Navy activities) will be the same under both Alternative 1 and Alternative 2. It is felt that this assumption is very conservative, that is, it tends to be biased in favor of Alternative 1 rather than Alternative 2.

Appendix I showed that the total annual rental cost of ADP equipment would be approximately the same under either alternative. However, under Alternative 2 many ADP operations would be centralized at a small number (one or two) of sites. Thus, if there are economies of scale (i.e., if the ratio of ADP personnel to ADP rental costs goes down as rental costs increase), then ADP personnel levels would tend to be lower in Alternative 2 than in Alternative 1.

In order to see whether the ratio of ADP personnel to ADP rental costs goes down as rental costs increase, data on ADP personnel (civilian and military) and on annual ADP rental costs were examined for a large number of Navy activities. The data used were the estimates for fiscal year 1962 which were submitted to the Navy Comptroller for budgetary purposes by various Navy bureaus and offices during August 1961. For BuSandA managed activities the budget submission dated 23 October 1961 was used. The data included all ADP applications, not merely those related to supply.

The data indicated that the assumption that the number of ADP personnel will be the same under both alternatives is conservative. There was some evidence to suggest that there may be some economies of scale. This is shown below.

First, the number of ADP personnel was plotted against annual ADP equipment rental costs for 40 of the 52 CONUS stock points considered in Appendix I (see Section C, item 1). The 12 stock points which were not included were omitted either because they do not have ADP equipment or because suitable data on their ADP operations were not available. The results are shown in Figure A-5. Initially, the data for supply centers and depots, shipyards, and air stations were plotted on separate charts. However, there were no significant differences in the data for the various types of stock points. In general, it appears that the number of ADP personnel is directly proportional to annual ADP rental costs. However, there is some indication that there may be some economies of scale when annual rental costs are very high (in excess of about $600,000).

To support this, consider data processing operations at ICP's. In many respects the data processing site (or sites) in Alternative 2 is more analogous to a large ADP installation at an ICP rather than to ADP installations at stock points. The large ICP's have fewer ADP personnel per dollar of annual ADP equipment rental costs than do stock points. For example, for the stock points shown in Figure A-5, there are over 305 ADP people per $1 million of annual rental costs. The comparable data for the five largest Navy managed ICP's are as follows:

ICP	Annual ADP Rental Cost (thousands)	Number of ADP Personnel	ADP Personnel per $1 million Rental
Ordnance Supply Office	$ 371.5	147	396
Defense Industrial Supply Center	679.3	227	334
Electronics Supply Office	772.5	149	193
Ships Parts Control Center	1,269.0	206	162
Aviation Supply Office	2,450.0	312	127

C. Stock Point Personnel

In this section the differences between Alternatives 1 and 2 in the numbers of people involved in functions currently performed at stock points, exclusive of people engaged in ADP operations, are estimated. This is equivalent to estimating the change in stock point personnel (exclusive of ADP personnel) under Alternative 2, since under Alternative 1 it is assumed that personnel

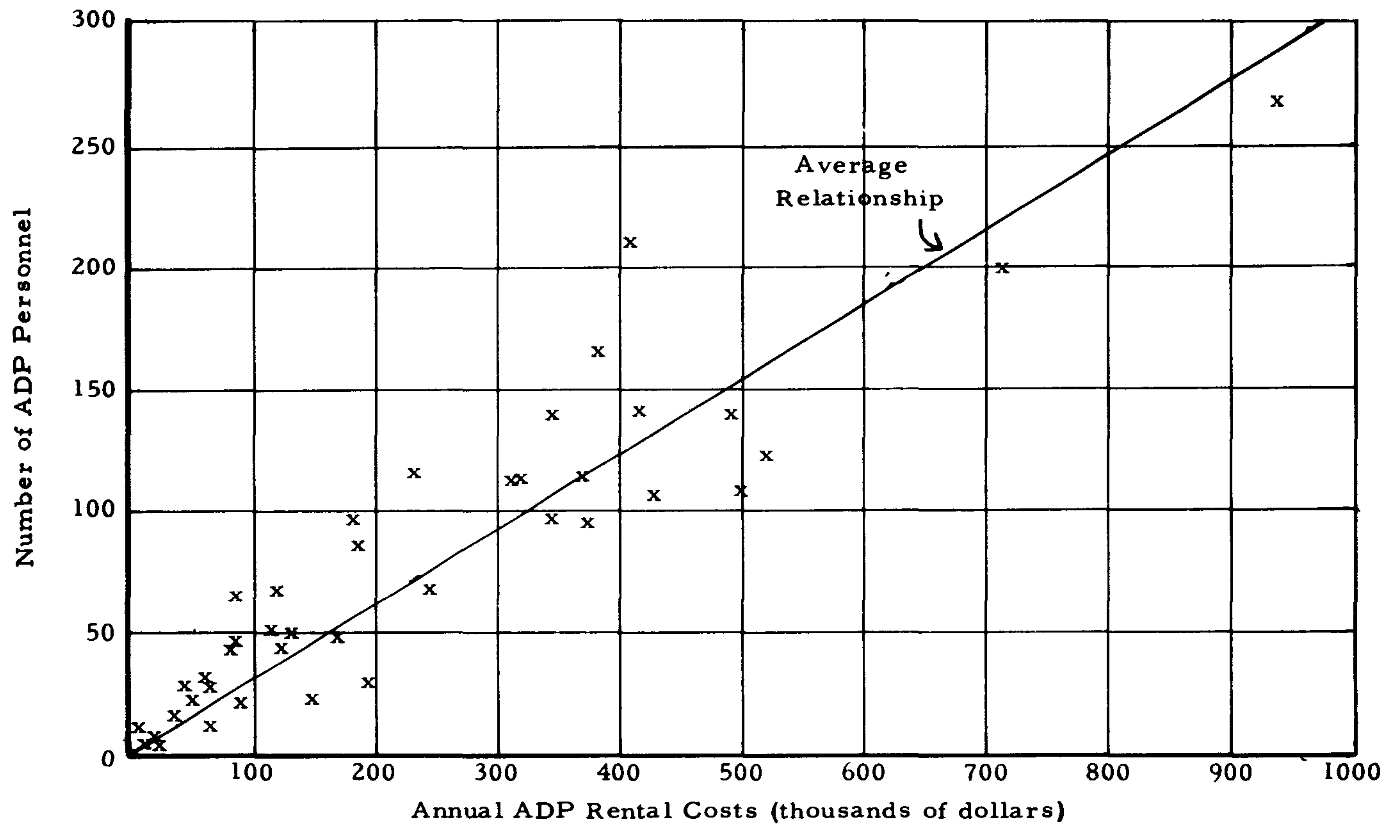

Figure A-5: Number of ADP Personnel vs. Annual ADP Rental Costs levels will be the same as they are currently. The estimation procedure used was as follows:

1. It was assumed that 52 CONUS stock points would be served by the system described in Alternative 2 and that these would be the same as the 52 stock points considered in Appendix I (see Section C, item 1). These were classified into three groups which were designated as follows:

   a. Supply centers and depots. This group consisted of the 9 CONUS supply centers and supply depots which are managed by BuSandA.

   b. Shipyards. This group consisted of the supply departments of the 10 CONUS shipyards which are managed by BuShips.

   c. Air stations. This group consisted of the supply departments of the 33 remaining activities. These CONUS activities are mainly air stations managed by BuWeps. However, they include some Marine Corps air stations, naval stations, etc.

2. Data on personnel levels (civilian and military) at each supply center and depot and in the supply department at each shipyard and air station were obtained. The totals for each type of activity were as follows:

Type of Stock Point	Total Number of Personnel
Supply centers and depots	17,958
Shipyards	6,470
Air Stations	12,143
Total	36,571

   The data for the supply centers and depots were as of 28 February 1962 and were obtained from the March 1962 issue of Personnel of the Naval Shore Establishment, NAVEXOS Publication 111. The data for the shipyards were as of July 1961 and were obtained from BuSandA Code H2. The data for the air stations were as of September 1961 and were obtained from BuWeps.

The number of personnel in the supply departments of two of the stock points was not available. These data were estimated from the relationship described in item 3 (below).

3. Figure A-6 shows the number of people at each supply center and depot and in the supply department at each shipyard and air station plotted against a measure of the relative level of workload at each stock point. The measure of workload is "total demand requests, line items" for all cogs of material for the period, 1 April 1961 through 30 June 1961, as reported in NAVSANDA Publication 295. The solid line in Figure A-6 shows the assumed relationship between number of people and workload level. Figure A-7 simply shows a portion of Figure A-6 in more detail.

   Initially, the data shown in Figure A-6 and A-7 were plotted separately for supply centers and depots, shipyards, and air stations. These plots did not indicate that there are significant differences in the personnel-workload relationships between the three types of stock points.

4. It was assumed that the jobs of people at stock points who charge time to certain work measurement functions (or an equivalent number of people) would be eliminated under Alternative 2 because the workloads that are associated with those functions would be handled at the central data processing site (or sites).

   The work measurement functions that were assumed to be wholly or partially eliminated were:

Function Number	Name of Function	% of Function Eliminated
134	Stores accounting	50%
136	Accounting for fund resources	50%
138	Accounting for receivables	50%
202	Issue control requisition processing	50%
204	Stock control document processing	100%
205	Financial inventory control operations	100%
421	Area material control	100%

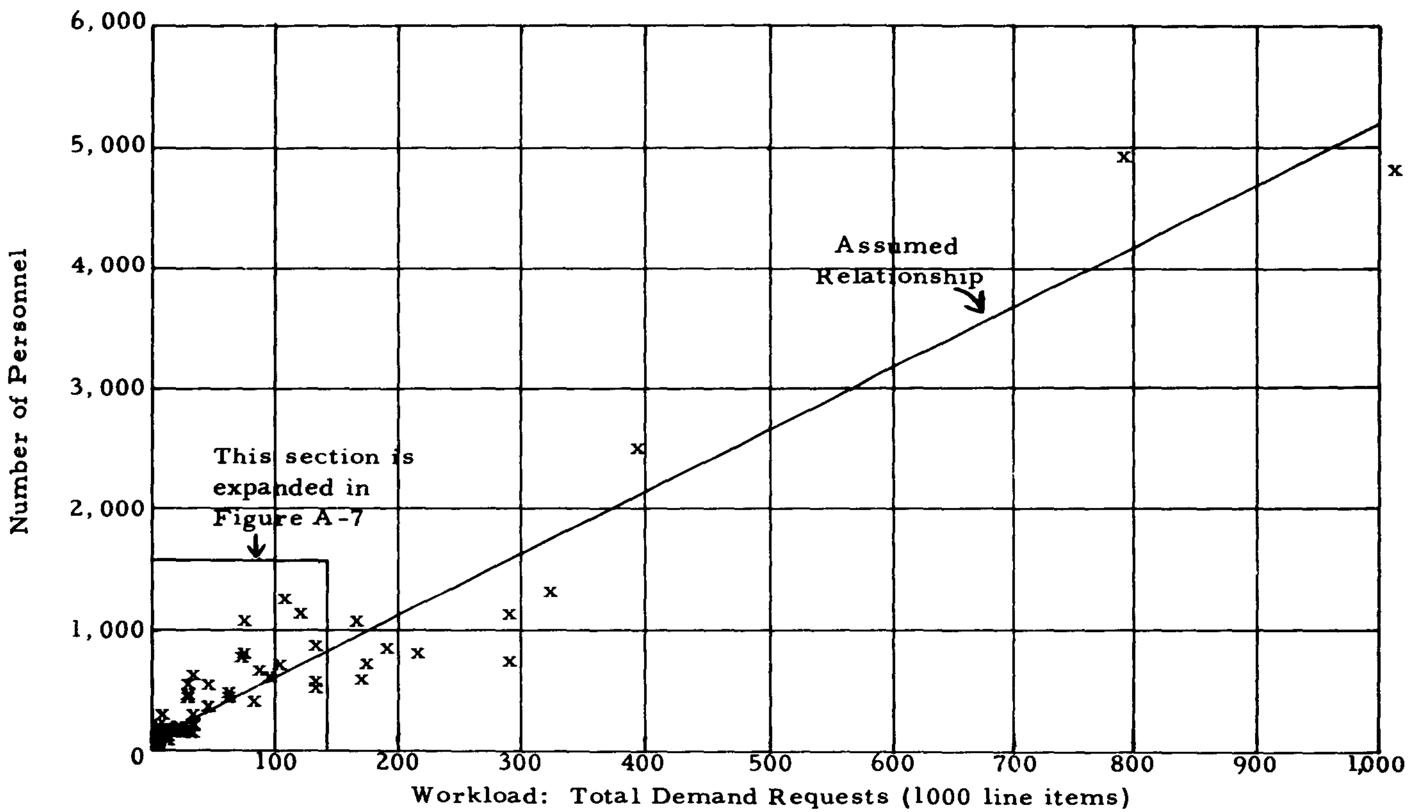

Figure A-6: Number of Personnel vs. Workload for Stock Point Supply Departments
1 April 1961 through 30 June 1961

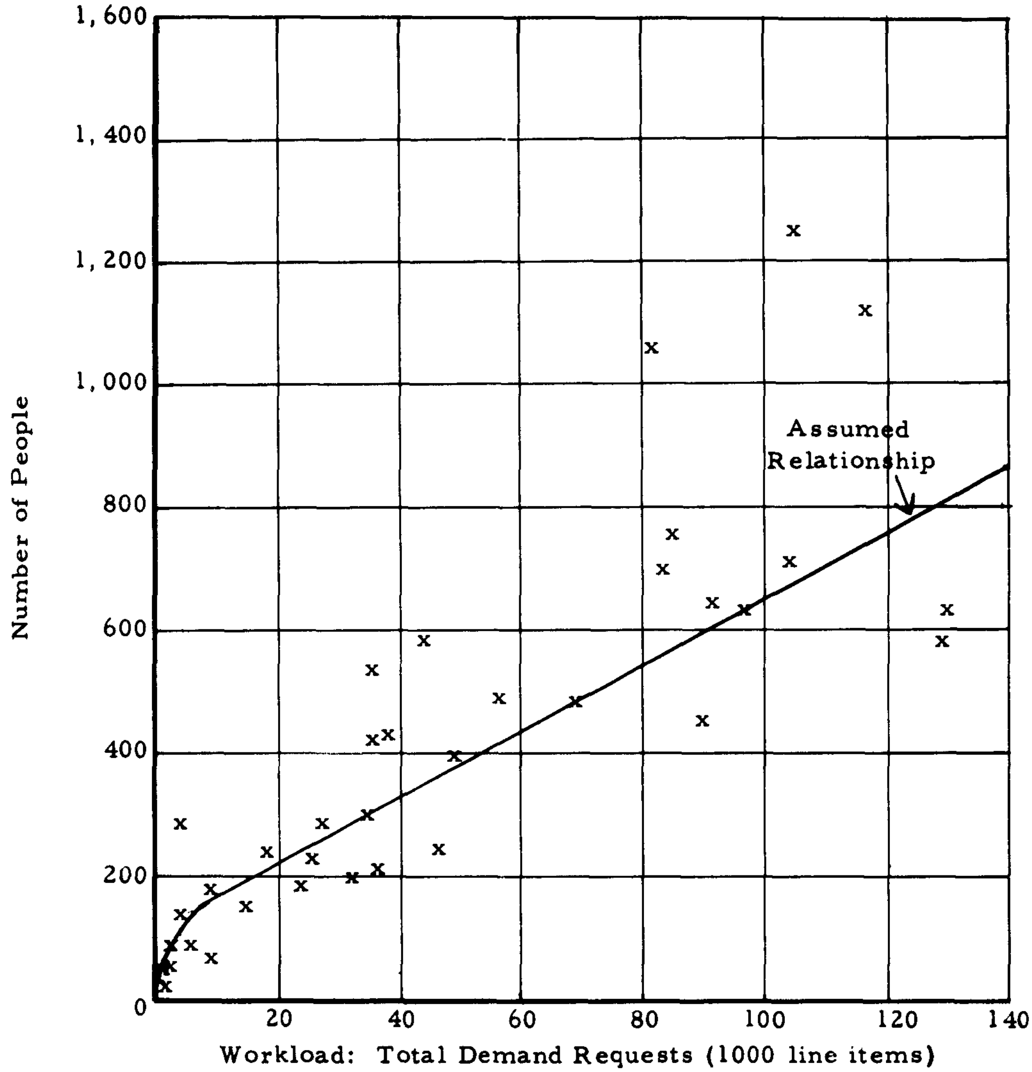

Figure A-7: Number of People vs. Workload for Stock Point Supply Departments 1 April 1961 through 30 June 1961

It is felt that this assumption is very conservative; that is, the workloads associated with many other work measurement functions might be processed centrally under Alternative 2.

Item 5 (below) shows the estimated total number of people who charge time to the functions that would be eliminated. This estimate however, includes certain ADP personnel, who, it has been assumed (see Section B) would not be eliminated. Thus, the net reduction in personnel is given by: (a) estimating the number of man-years involved in the function eliminated, and (b) subtracting from this the number of ADP personnel. This is shown in item 6 (below).

5. The percentage of people who charge time to the functions that would be eliminated under Alternative 2 (see item 4, above) was estimated from work measurement data for all 15 supply centers and depots and for the 12 shipyards (including the Naval Weapons Plant in Washington) because the work measurement data were summarized for all depots and yards and were not available for air stations. These data include civilian and military personnel and are maintained by BuSandA Code D1. The data used for supply centers and depots covered the period 1 July 1961 through 31 December 1961. The data used for shipyards covered the period, 1 July 1961 through 30 September 1961. The basic data, which showed total man-months by function number were converted to staffing level by function number. (That is, the supply center data were divided by 6 and the shipyard data by 3.)

   From these data, the percentage of people performing the type of functions that would be eliminated under Alternative 2 was calculated as follows:

Type of Stock Point	Total Number of Personnel in: All Functions	Total Number of Personnel in: Eliminated Functions (see item 4, above)	Personnel Eliminated(%) Col. (3) ÷ Col. (2)
(1)	(2)	(3)	(4)
Supply centers and depots	24,813.9 *	2,381.9	9.60%
Shipyards	4,751.8 **	467.3	9.83%
Total	29,565.7	2,849.2	9.64%

* This number is based on all of the depots.

** Although this number is based on all of the shipyards, it is for the BuSandA funded portion only.

It was assumed that 9.64% of the personnel at all types of stock points would be eliminated under Alternative 2. This yielded the following estimated savings:

Type of Stock Point (1)	Total Number of Personnel (see item 2 above) (2)	Number of People Eliminated 9.64% of col. (2) (3)
Supply centers and depots	17,958	1,731.2
Shipyards	6,470	623.7
Air stations	12,143	1,170.6
Total	36,571	3,525.5

6. Work measurement data on EAM and EDPM operations for each of the nine CONUS supply centers and depots for fiscal year 1961 were used in order to estimate the number of ADP personnel included in the savings calculated above. These data were obtained from BuSandA Code H2. The data showed that 374.7 man-years of ADP personnel at supply centers and depots were charged to the functions or portions thereof, that would be eliminated (see item 4 above). Thus, the net number of personnel that would be eliminated at supply centers and depots is 1,731.2 - 374.7, or 1,356.5. This is 78.36% of the savings indicated in item 5 (above). It was assumed that this percentage would also apply to shipyards and air stations. Thus, the estimated net personnel savings is:

Type of Stock Point	Number of People Eliminated
Supply centers and depots	1,357
Shipyards	489
Air stations	917
Total	2,763

7. In conclusion, it is estimated that under Alternative 2 the number of people, exclusive of ADP personnel, involved in functions currently performed at stock points would be reduced by 2,763. This estimate is regarded as being quite conservative.

D. ICP Personnel [1]

In this section the differences between Alternatives 1 and 2 in the number of people involved in functions currently performed at ICP's, exclusive of people engaged in ADP operations, is estimated. This is equivalent to estimating the change in ICP personnel (exclusive of ADP personnel) under Alternative 2, since under Alternative 1 it is assumed that personnel levels will be the same as they are currently. The estimation procedure used was as follows:

1. It was assumed that personnel at DSA activities would not be affected by Alternative 2. Actually, there might be reductions in personnel levels at DSA Defense Supply Centers and at DSA Routing Centers, as well as at Navy ICP's. However, in this analysis the more conservative assumption is made.

Personnel levels at Navy ICP's as of 28 February 1962 were obtained from the March 1962 issue of Personnel of the Navy Shore Establishment, NAVEXOS Publication 111. These data, including military as well as civilian personnel, were as follows: [2]

ICP	Personnel on Board
Electronics Supply Office	1,155
Aviation Supply Office	2,366
Navy Subsistence Office	61
Yards and Docks Supply Office	430
Fuel Supply Office	74
Clothing and Textile Office	68
Ships Parts Control Center	1,539
Forms and Publications Supply Office	110
Ordnance Supply Office	783
Total	6,586

[1] For purposes of this paper the term ICP includes retail offices.

[2] The Fleet Material Support Office (FMSO) was not included here because staffing level was not available at the time the report was prepared. As such, the estimates are again conservative.

2. It was assumed that one-half of the jobs of people at ICP's who charge time to workmeasurement function number 601 (i.e., Stock Control), or an equivalent number of people, would be eliminated under Alternative 2 because most of the workloads that are associated with this function would be handled at the central data processing site (or sites). This allows for the fact that some of the people who charge time to function number 601 are ADP personnel.

The foregoing assumption is considered to be quite conservative; that is, the workloads associated with other measurement functions might be processed centrally under Alternative 2.

3. Work measurement data for the nine Navy ICP's listed in item 1 (above) for the period, 1 July 1961 through 31 December 1961, were obtained from BuSandA Code D1. These data included military as well as civilian personnel. The basic data, which showed man-months by function number were converted to staffing levels by function number on the basis of a 40-hour work week.

The data indicated that the total staffing level of the nine Navy ICP's was 6,998.6 people. This does not include function number 613 (i.e., Accelerated Item Reduction) which is used primarily at NSC Bayonne. Staffing for function number 601 was 1,731.0 people. Thus, it was assumed that under Alternative 2, total staffing at ICP's would be reduced by .50 x 1,731 ÷ 6,898.6% Or 12.55% (see item 2, above).

4. It was estimated that the jobs of 12.55% of the 6,586 people (see item 1, above) involved in functions currently performed at Navy ICP's would be eliminated. Thus, the estimated reduction of ICP personnel, exclusive of ADP personnel, under Alternative 2 is 827 people.

E. Dollar Costs

The average annual cost per employee for the type of jobs that would be eliminated under Alternative 2 was assumed to be $5,880. This is the product of the following three numbers:

1. $2.63 - This is the average hourly earnings of all graded BuSandA employees during January 1962, as reported in the March 1962 issue of Personnel of the Naval Shore Establishment, NAVEXOS Publication 111.

2. 2087 - This is the average number of hours paid per employee per year, excluding overtime.

3. 1.07117 - This provides an allowance for the cost of fringe benefits of slightly over 7% of salary. The figure was obtained from A Study of Procurement Costs at the Ships Parts Control Center, 31 July 1961, Volume II, page 3, which was prepared for BuSandA by Dunlap and Associates, Inc., under Contract Number Nonr-2860(00).

The number of personnel that would be saved at stock points and at ICP's under Alternative 2, as estimated in Sections C and D of this appendix are 2,763 and 827, respectively. Thus, the estimated total annual saving in personnel costs is $5,880 x (2763+ 827), or $21.1 million.

It should be re-emphasized that the savings in personnel costs estimated above are very conservative. Alternative 2 may result in substantially larger savings than those indicated herein because:

1. There may be a substantial reduction in the number of ADP personnel required under Alternative 2, which has not been taken into consideration in this analysis (see Section B of this appendix).

2. Personnel savings (excluding ADP personnel) at CONUS stock points and at ICP's may be considerably larger than those indicated herein because additional workloads might be handled at the central data processing site (or sites). Also, savings in the numbers of support personnel (i.e., personnel engaged in such functions as administrative services, industrial relations, medical and dental care, etc.) which might result from a reduction in the number of productive personnel have not been taken into consideration.

3. Possible reductions in workloads and personnel at overseas stock points and at DSA activities have not been considered.

4. The assumed average annual dollar savings per employee saved may be too low. For example, the cost of providing working facilities and supplies for employees is neglected, the assumed cost of fringe benefits may be too low, and savings in wage payments in excess of 40 hours per week are omitted.

In summary, it is estimated that personnel costs under Alternative 2 would be at least $21.1 million lower than those in Alternative 1.

APPENDIX III

CALCULATION OF COMPARATIVE ELAPSED TIMES

In this appendix the elapsed times required to satisfy requisitions under Alternatives 1 and 2 are estimated and compared. The elapsed times considered are the time intervals between the submission of requisitions to Navy stock points and the issuance of materials by the stock points to satisfy those requisitions. Such elapsed times are regarded as highly important measures of the performance of the CONUS logistics system.

The elapsed times under Alternatives 1 and 2 can be estimated and compared for a wide variety of different situations (e. g., types and priorities of requisitions; requisitions for in-stock, not-in-stock, and non-stocked items; ICP policies; etc.). This appendix will not show the estimated elapsed times under all possible situations. Rather, it will show the estimated elapsed times for a small number of situations that occur very frequently.

In Working Paper No. 6 (Models of the Supply System Ashore, 20 June 1962) Dunlap and Associates, Inc., presented a model for estimating elapsed times for the supply systems ashore. Table 3 of that paper showed estimated average elapsed times for various standardized supply tasks, called "elemental elapsed times." Table A-1 of this paper shows the corresponding average elemental elapsed times as estimated for Alternatives 1 and 2. The data for Alternative 1 are based on Table 3 in Working Paper No. 6. The data for Alternative 2 are different only in that the times involved in processing issue paper at field activities, in communicating between two Navy activities, and in processing redistributions at ICP's (which, under this alternative, is performed at the central ADP site) are negligible.

The data in Table A-1 can be used to compare the elapsed times under Alternatives 1 and 2 for many different situations. Such comparisons are made in Table A-2 for the processing of routine and priority requisitions in each of four different situations. The four situations shown in Table A-2 are similar to the four situations shown in Table 4 of Working Paper No. 6. This was done partly for the convenience of the reader in following the discussion and partly because they are situations that are likely to occur with a high degree of frequency. It was assumed that "tapping" is allowed in Alternative 1. Of course, tapping is not permitted in Alternative 2.

Table A-1

Average Elemental Elapsed Times

	Elapsed Time in Days			
	Alternative 1		Alternative 2	
	Routine	Priority	Routine	Priority
Process issue paper at field activity	2	1	0	0
Process issue paper at central ADP site	*	*	0	0
Process local procurement at field activity	3	1	3	1
Accomplish physical issue at field activity	2	1	2	1
Communicate between two Navy activities	1	1	0	0
Process redistribution at ICP or central ADP site, as appropriate	3	1	0	0
Procure at ICP or ADP site for end use	15	10	15	10
Procure at ICP or ADP site for stock	70	**	70	**
Consolidation time	5	0	5	0
Transportation time	8	3	8	3

* Under Alternative 1 there is no central ADP site.

** Normally items procured for stock are not treated as priority items.

The elapsed times for all of the situations shown in Table A-2 are considerably lower under Alternative 2 than they are under Alternative 1. The savings in time under Alternative 2 as compared with Alternative 1 range from 19 per cent to 50 per cent for routine requisitions and from 18 per cent to 58 per cent for priority requisitions. Similarly, large savings in elapsed time under Alternative 2 can be expected under most other situations that are likely to occur frequently. Thus, in terms of elapsed times, Alternative 2 is clearly to be preferred over Alternative 1.

Table A-2

Comparison of Elapsed Times under Several Situations

Alternative 1			Alternative 2		
	Time in Days			Time in Days	
Element	Routine	Priority	Element	Routine	Priority
Situation A - Material in stock.					
Process issue paper at field activity	2	1	Process issue paper at field activity	0	0
			Communicate with ADP site	0	0
			Process issue paper at ADP site	0	0
			Communicate with field activity	0	0
Accomplish physical issue	2	1	Accomplish physical issue	2	1
Total	4	2	Total	2	1
Advantage of Alternative 2 - routine - 50% priority- 50%					
Situation B - Material available at another activity in system.					
Process issue paper at field activity	2	1	Process issue paper at field activity	0	0
			Communicate with ADP site	0	0
			Process issue paper at ADP site	0	0

Table A-2 (Continued)

Alternative 1			Alternative 2		
	Time in Days			Time in Days	
Element	Routine	Priority	Element	Routine	Priority
Situation B - (Continued)					
Communicate with other field activity	1	1	Communicate with other field activity	0	0
Process issue paper at other field activity	2	1	Process issue paper at other field activity	0	0
Accomplish physical issue	2	1	Accomplish physical issue	2	1
Consolidate shipment	5	0	Consolidate shipment	5	0
Transportation time	8	3	Transportation time	8	3
Accomplish physical issue	2	1	Accomplish physical issue	2	1
Total	22	8	Total	17	5

Advantage of Alternative 2 - routine - 23%
priority - 38%

Situation C - Material available in system, but not at "passed to" activity.

Process issue paper at field activity	2	1	Process issue paper at field activity	0	0
Communicate with other field activity	1	1			
Process issue paper at other field activity	2	1			

Table A-2 (Continued)

Alternative 1 Element	Time in Days Routine	Time in Days Priority	Alternative 2 Element	Time in Days Routine	Time in Days Priority
Situation C - (Continued)					
Communicate with ICP	1	1	Communicate with ADP site	0	0
Process redistribution at ICP	3	1	Process redistribution at ADP site	0	0
Communicate with other field activity	1	1	Communicate with other field activity	0	0
Process issue paper at other field activity	2	1	Process issue paper at other field activity	0	0
Accomplish physical issue	2	1	Accomplish physical issue	2	1
Consolidate shipment	5	0	Consolidate shipment	5	0
Transportation time	8	3	Transportation time	8	3
Accomplish physical issue	2	1	Accomplish physical issue	2	1
Total	29	12	Total	17	5
Advantage of Alternative 2 - routine - 41%					
priority- 58%					
Situation D - Material not available in system					
Process issue paper at field activity	2	1	Process issue paper at field activity	0	0
Communicate with ICP	1	1	Communicate with ADP site	0	0

Table A-2 (Continued)

Alternative 1			Alternative 2		
	Time in Days			Time in Days	
Element	Routine	Priority	Element	Routine	Priority
Situation D - (Continued)					
Process redistribution at ICP	3	1	Process redistribution at ADP site	0	0
			Communicate with ICP	0	0
Accomplish procurement	15	10	Accomplish procurement	15	10
Manufacturing lead time	t	t	Manufacturing lead time	t	t
Transportation time	8	3	Transportation time	8	3
Accomplish physical issue	2	1	Accomplish physical issue	2	1
Total	31 + t	17 + t	Total	25 + t	14 + t

Advantage of Alternative 2 (excluding manufacturing lead time) - routine - 19%
priority - 18%